THE

# ELECTRICAL REVIEW.

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## ELECTRIC TRACTION.

PAPERS on this subject were read last week at the Institution of Electrical Engineers by Mr. H. D. Wilkinson, Messrs. R. W. Blackwell, and Philip Dawson. Mr. Wilkinson's paper was a supplementary one to that read last session, and deal principally with trolley working and line construction, and, so far, there is nothing new advanced, the matter being principally descriptive of American experience and practice. The advantages of trolley working of electric tramways are set forth in glowing terms, the details being considered wonderfully perfect, and yet towards the close of the paper we are informed that in one large system no less than 20 short-circuits per day is the average, caused by high winds shifting overhead gear, by falling poles or wires, and sometimes by the trolley wire falling on the rails or ground. Is that good engineering?

Belt driving for railway generators seems at last to be condemned in America, and direct driving adopted, a practice European engineers fell in with years ago.

We agree with the author in his opinions regarding the introduction of electric traction in many places in this country, for there are numerous cases where it would pay and be of great value, provided a perfect trolley system could be introduced, and overhead construction tolerated. From the paper it would seem that, in spite of the great application of electric traction in America, they are still improving in important points, so that what is the best practice to-day is bettered by some improvements next day, and so on; but the paper is only of value as showing us the American march of progress.

The second paper is another of the same kind, descriptive of American lines, principally referring to trolley wires and line construction, and the bonding of the rails by copper bonds and by welding is discussed.

The details of line construction are entered into at very great length, numerous examples of insulators and wire supports being shown.

Both papers assume that the American electric traction system might be copied with advantage on this side, but neither of them submit any modifications calculated to adapt electric traction methods to the different conditions existing here. We feel certain that when electric traction moves in this country, British engineers will not copy the details of American practice, but will work out the problems in their own way. Electrical engineering methods differ considerably here in engines, dynamos, and motors, from those of the States, and in electric traction the same differences may be expected.

## A STANDARD UNIT OF LIGHT.

The staff of the German Reichsanstalt have recently been busying themselves with the problem of obtaining a standard unit of light which shall be as constant as possible, and be capable of being reproduced at any time from the specifications given. The apparatus devised is somewhat complicated, but it can be relied upon not to vary in different apparatus more than 1 per cent. After much research it was finally decided to take, as the standard unit, the amount of light emitted by a square centimetre of platinum foil when heated to a fixed temperature, to be determined by means of a bolometer and an absorption vessel. The platinum foil was heated by an electric current capable of being varied by a rheostat till the required temperature was produced. Surrounding the platinum was a chamber whose walls were kept at a constant temperature by water circulation, the front wall consisting of a screen with an aperture exactly one square centimetre in area. In front of the aperture was placed a screen with a shutter, and beyond the screen was placed the bolometer. When the shutter is raised, the light from the glowing platinum impinges on the bolometer, and produces a deflection, which is noted. An absorption vessel is now introduced between the shutter and the bolometer, and the latter is then moved nearer to the source of light till an equal deflection is produced. If the relative distances of the bolometer from the platinum indicates a fixed ratio, say, of 10 : 1 between the temperatures produced at a given distance by the platinum with and without the absorption vessel, then the platinum has the specified temperature, otherwise the current through the platinum must be varied till the desired indications in the bolometer are obtained. The absorption vessel consists of a cylindrical glass ring, whose ends are closed by two parallel quartz plates, each 1 mm. thick, and enclosing a layer of water 2 mm. thick. The bolometer wire is coated with a layer of platinum black of definite thickness; this was found to give more constant results than carbon black coatings. In the description of the apparatus given by Von. O. Lummer and F. Kurlbaum (*Elec. Zeit.*, No. 35, p. 474), the influence of errors in different parts of the apparatus in producing errors in the final result are investigated, and it is shown that an accuracy not varying more than 1 per cent. is easily attainable. The Reichsanstalt has decided to use this unit in future to standardise the less elaborate and less constant units used in practice. Why is there no Royal or Imperial Institute in this country to perform a like important service for our scientific and technical men? How much longer shall we have to remain satisfied with our English standard candle, six to the pound, each burning 120 grains per hour (if it should so happen) of sperm of uncertain composition?

## THE UTILISATION OF REFUSE.

The utilisation of ash-bin refuse for steam generation is a subject that is daily occupying increased attention from local authorities who wish to dispose hygienically of the ash-bin refuse in their districts, and, at the same time, have to consider the problem of cheap fuel for their electricity supply stations; and papers on this subject are, therefore, at the present moment very acceptable, so far as they point out what actual experience shows to have already been achieved in this way, and what further developments may be relied upon under properly-arranged conditions.

A paper on this subject, by Mr. T. W. Baker, was read before the Society of Engineers on October 1st, and the discussion on the paper took place on November 5th last. This paper is devoted, to a certain extent, to a description of some of those dust destructors in which steam in fair quantities is being generated by the combustion of the ash-bin refuse, but chiefly to an elaborate description of a dust destructor for steam generation devised by Mr. Baker himself. Unfortunately, those hoping to be instructed by a perusal of this paper will, in the main, be entirely misdirected, as the reasons put forth by Mr. Baker for his particular design of destructor are reasons which exist only in his mind, and are not in accordance with the well understood laws of thermo-dynamics. In introducing his destructor, Mr. Baker makes the extraordinary statement that the temperature reached and maintained in the flues of a forced draught destructor—even 2,000° Fahrenheit—is not sufficient to produce steam at a greater pressure than 60 to 80 lbs. to the square inch, and that he therefore adds a supplementary furnace to his destructor fired with coal to increase the temperature sufficiently to obtain steam at this pressure. It must have been evident to all his hearers that Mr. Baker started with a most remarkable proposition, and although it was pointed out by several during the discussion that steam at 140 lbs. pressure has a temperature of only 350° Fah., and therefore gases at a temperature of 2,000° must be able to produce steam at such a pressure, nevertheless the author adhered to this extraordinary statement, probably for the reason that if it were not necessary to add coal to raise the temperature, any small novelty in his proposed form of destructor would entirely disappear; and after refusing to be instructed on this matter by such authorities on steam as Mr. Shönheyden and Mr. Druitt Halpin, he advanced as an argument that his basis proposition was correct, from the fact that with a forced draught destructor, such as that at Warrington, only 66 lbs. steam pressure is attained, although the gases there are over 2,000° Fah. It would be about as reasonable to state that because steam is generated at 40 lbs. pressure in a boiler burning coal, it could not be produced at 140 lbs. pressure with the same coal; or that if a boiler had its safety valve loaded to 20 lbs., it must nevertheless produce steam at 140 lbs. if the proper kind of fuel, according to Mr. Baker's ideas, was burnt in that boiler. We need not, however, further dwell upon absurdities such as these, and we can only regret that a paper containing statements so contrary to scientific facts should circulate amongst those who having no technical knowledge themselves, expect to be instructed by the publication of such documents.

We regard this question of the generation of steam from ash-bin refuse as most important. The results obtained with forced draught destructors in the way of steam generation are of the most encouraging kind, and the tests that have from time to time been made at Warrington, where a large amount of steam work is daily performed by the destruction of ash-bin refuse, are such as to leave no doubt of its value. Taking as a typical instance our own smaller London vestries, who have each, on an average, at least 500 tons of refuse to

dispose of weekly, then on the basis of the results obtained at Warrington, where a pound of water is evaporated for a pound of refuse burnt, a continuous output for each of the 18 hours each day of the six days that make a working week of at least 500 H.P. could be depended on. With this big basis to work upon it can well be left to our engineers to devise means of rendering this large horse-power effective for electric lighting works, such as the introduction of Mr. Druitt Halpin's thermal storage system, or, as suggested by Mr. Manville, by the burning of coal as an auxiliary during heavy load times, not for the purpose of raising the pressure of the steam as propounded by Mr. Baker, but for the increase of the power available during the few hours of heavy load.

## ELECTRICITY AS A FIRE HAZARD.

The "World's Fair" of last year was responsible for many congresses and social gatherings of various orders being held in the far-famed city of the West. It was only fitting, therefore, that the insurance underwriters of the States, amongst others, should assemble in congress within the precincts of the great show, and thus happily combine pleasure with business. It was also no doubt right and proper that in the midst of their festivities, like the Egyptians of old, they should be reminded of more serious matters, and perhaps as a shocker, nothing more suitable could have been paraded than that well worn skeleton—the "electrical fire hazard." For, rightly or wrongly, the fire underwriter does largely attribute his heavy losses of late years in the States to the electrical fiend.

The *Electrical Engineer* of New York lately reproduced, in nine weekly instalments, a paper on the above subject by Mr. W. J. Jenks, as read before the Insurance Congress, Chicago, 1893. The paper deals at some length with the effects of leakages in underground and overhead mains upon house wiring, and the dangers of various forms of "earths" and "shorts" due to such leakages. In fact, the theme is *insulation*, the author incidentally touching upon the origin of insurance rules, and quoting various authorities upon the weakness of wood casing as protection to conductors—our old friend the gas pipe being recommended instead. No doubt there is a very great deal to be said in favour of iron barrel piping, particularly where conductors are hidden from view and embedded in walls, but it will not recommend itself to the multitude, with whom cheapness is the first consideration. Our readers will doubtless be glad to know that the standard of wiring in the States is now said by American experts to be quite equal to the best work on this side of the water—neither, however, being perfect, and both subject to occasional breakdowns and minor casualties. Mr. Jenks, doubtless recognising the special circumstances of the occasion, departed from the usual single line diagrams, and illustrated his paper with highly-coloured drawings, showing dynamos in perspective, conductors of gigantic proportions with their insulation laid bare, solid and substantial gas fittings, and the "earths" decidedly earthy; the whole well peppered with arrows indicating the direction the current should go when all is in order, and where it is likely to go when led into temptation. The paper is well worth reading by those interested in the subject from a fire point of view; but in some respects it is decidedly disappointing, and scarcely so advanced as we should have expected from Chicago. The author, for instance, has nothing to say about the complications of the *three* and *five-wire* systems of distribution, now so much in vogue, nor of that bugbear "electrolysis," as affecting gas and water pipes.

There is on record in this country a fire produced by an electrical discharge from an iron pipe enclosing a faulty high tension main, whereby a neighbouring gas pipe was perforated as though by red hot shot. In the opinion of experts, this perforation was due to the water running down the iron pipe becoming so strongly electrified as to be repelled, or discharged, with sufficient force to penetrate the soft metal gas pipe near! Now, a coloured diagram of a bombardment of gas pipes with electrified water would have been highly effective, and a better hair raiser than mere short circuits in simple parallel, as served up by Mr. Jenks for the edification of the Chicago Congress.

Symbols and Abbreviations.

Referring to the letter which we reproduced in our last issue, from the *Electrical World*, we should like to offer some remarks. The writer says, that one of the fundamental principles (by the way, we have never yet seen any authoritative enunciation of these so-called principles) of the Congress system is "to use script or oblique letters as symbols for quantities, and perpendicular letters for the names of units or their abbreviations." Now, script letters such as those shown, both in the *Electrical World* and in this paper are *perpendicular* letters. If it was necessary then to substitute perpendicular letters at all for oblique ones, we cannot see any valid reason whatever for preferring script to block letters. For ease in reading and in writing, the latter are very much to be preferred, though, strange to say, M. Hospitalier seems to think otherwise. The greatest practical use which will be made of any system, apart from books, will be by the large army of professors and lecturers, and the time which would be saved to them and their students by the adoption of the easy M and H instead of the troublesome French script is a matter for consideration. One thing is certain, that they would have to learn how to write a new alphabet. Apart from this, the block letters have been, and are being used by nearly all the leading writers on magnetism of the present day. Ewing, Fleming, and S. P. Thompson, all use them in their well-known works; and, *mirabile dictu*, the secretary of the committee which recommended the use of *script* letters, Prof. Nichols, of Cornell University, in his newly published *Laboratory Manual of Physics and Applied Electricity*, himself uses repeatedly, between pp. 201 and 205, *block* letters to represent magnetic quantities. Regarding the vexed question of $C$ or $I$ for current strength, we are decidedly of opinion that to use $I$ would oblige teachers to explain the French use of the word 'intensity,' and that this would lead students to form a totally wrong idea of what strength of current actually means. In short, as Prof. Jamieson has tersely put it in his strictures on the Committee's recommendations, this word 'intensity' has *no meaning* to English speaking people when used in this sense, and would very likely never be used. Why then prefer the initial letter of 'intensity,' a word which will never be heard, before that of the word 'current,' which is in constant use by British, Americans, and foreigners alike? If the American Institute of Electrical Engineers adopt the symbol $I$ to represent current, they will prove false to the recommendations of their own Badge Committee, which, in the face of the recommendations of the Congress Committee, adopted as *their* mystic symbol, the well-known formula $C = \frac{E}{R}$. (For illustrations, see the *Electrical World*, December 2nd, 1893, p. 424). Does this not look somewhat like a tacit vote of censure? It is evident that Professor Macfarlane agrees with Professor Jamieson's suggestion about the use of the solidus (/) instead of the colon (:) for *per*. In regard to his other objections, we may take another opportunity of discussing them more in detail.

## TYER'S IMPROVEMENTS IN LOCK AND BLOCK ELECTRIC APPARATUS FOR RAILWAYS.

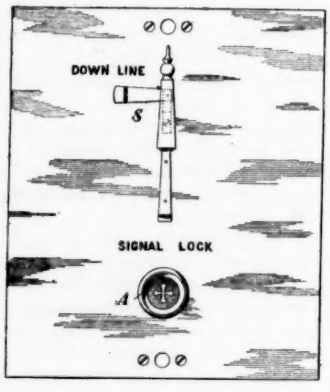
On many lines of railway worked on the "Absolute Block" system, there are instruments having either two indicating needles, or two miniature semaphore arms moved by polarised cylindrical armatures; these needles or arms being moved to indicate when the section of the line to which they relate is occupied, or clear. The object of the new arrangement is so to connect this instrument to the lever which works the outdoor signal allowing a train to enter the section, that, when this signal has once been lowered to admit a train the signalman at the distant cabin cannot again operate his instrument so as to permit of the outdoor signal being again lowered when once a train has entered the section. The arrangement thus provides against the negligence of the distant signalman who, having once signalled that the line was clear, and received the intimation that a train had in consequence been admitted to the section, might omit to put his signalling instrument in such a condition that he cannot again signal that the line is clear.

Fig. 1 is a front view of the block signalling instrument.

Fig. 2 is a view of the same with the front plate removed.

Fig. 3 is a plan of the contact apparatus worked by the outdoor signal lever.

Fig. 1.




The lower needle or semaphore arm of the ordinary block instrument is removed, and a movable screen, A, substituted, which, when moved aside, discloses the signal "Free," meaning that the signal lock is free.

To the tail end of the screen, A, is attached a contact plate, which, when the screen is in the dotted position disclosing "Free," comes into contact with a pin, *a*, and closes the circuit of a local battery with the electrical "lock" attached to the signal lever, permitting the lever to be moved and the outdoor signal to be lowered. Fixed in a convenient position near the signal lever, is a frame, B, in which is mounted a sliding rod, C, urged in the one direction by a spring, D (or it might be a weight), and pressed upon or connected to the signal lever so as to be moved in the direction of the arrow by the signal lever acting on its head, *c*, when the signal lever is moved to admit a train to the section.

Fig. 2.

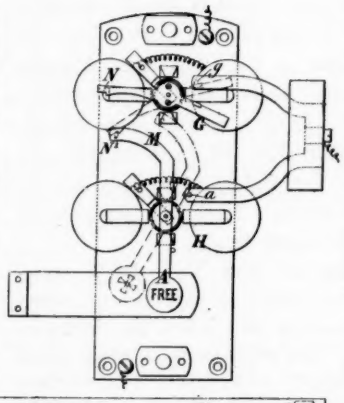
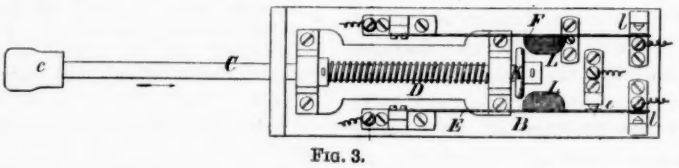



Fig. 3.




On each side of this rod is a blade spring, E and F, the one of which, E, usually makes a contact at *e*, whereby the coils of two electro-magnets, G and H, that work respectively the small semaphore, S, and the screen, A, of the block instrument are connected in series, so that, when the distant signalman sends a current by the line, the semaphore arm, S, is lowered to indicate that the section is clear, and the screen by disclosing the word "Free" indicates that the outdoor signal is unlocked. When, in obedience to this indication, the signal lever is moved to admit a train to the section, it moves the sliding rod, C, and a collar, K, upon it, as it passes insulated protuberances, L, L, on the springs at each side of it, moves these springs apart breaking the contact that formerly existed at *e*, and making a momentary contact at *l*, *l*, by which a local battery is put in circuit with the electro-magnet, H, that works the screen, A. The screen is thus moved so as to obstruct the "Free" indication, and its arm, M, acts on an arm, N, on the axis of the small semaphore, S, moving the semaphore so as to break a contact at *y*, from the electro-magnet which locks the signal lever, the arm, M, of the screen becoming itself caught behind a shoulder of the semaphore arm, N, as indicated at N¹, so that the screen cannot again be moved aside until the small semaphore, S, has been raised to indicate "Danger" and has thereby released the arm of the screen.

## THE STREET RAILWAYS OF ATLANTA.

The City of Atlanta has, says the *Electrical World*, a greater mileage of tramways than any other city in the United States per head of population.

With a population of only 110,000, it has the equivalent of 96 miles of single track, all of which, except ·8 mile, over which a mule hauls one car per day to hold the franchise, are electrically worked.

The principal company operates some 63 miles, of which 33 are on paved streets; employs a 40-lb. tee rail on 44 miles, and 40-lb. to 56-lb. girder rails on the remainder, with pine and oak sleepers.

The overhead structure—for of course the overhead wire is used—is a No. 0 copper wire on hangers of the General Electric type. Within a quarter of a mile radius of the city centre, Walworth, 27 feet high poles are used; otherwise wood is the material of the poles. All the city lines have a span supported trolley; outside the city, bracket construction is used. On the ground return a No. 0 copper wire connects to the rails at each side of each joint, but on newer portions the rails are simply made continuous by means of No. 0 copper bonds.

The motor equipment includes 60 double motor trucks, single reduction, and chiefly of 15 H.P. per each motor. The trucks are used under 47 box cars in winter and 40 open cars in summer.

Boilers of 700 H.P. rating are employed, and engines to drive one 500 and two 300 kw. generators for the western side of the city.

The condensing water is run over a 20-feet fall in a wooden chamber, and meets currents of air from four fans, which are forced into the box to cool the water by evaporation.

For the east side of the city power is furnished by the Georgia Electric Light Company per metre for 2·7 cents per kw. hour, there being five 90 kw. generators installed by the tramway company at their own expense. Operating expenses were 68·3 per cent. of the gross earnings during the last financial year. The average daily car mileage was 4,500, allowing an income of 18·2 cents per car mile, as against $21\frac{4}{10}$ in 1893. The operating expenses, however, are only $12\frac{1}{2}$ cents as against $15\frac{9}{10}$ cents in 1893. The annual loss, after payment of interest, &c., is £5,000. Seeing that mileage has over-run population, it would appear that there is an assured future for the company.

Our contemporary furnishes similar information upon the other lines of Atlanta, and what appears noticeable is the variety of the car and motor equipment, and this feature, by no means an uncommon one, strikes us as a probable reason for one source of loss. Only those intimately conversant with railway work know the innumerable continual losses which arise from too great a diversity of rolling stock. Another source of loss on one of the Atlanta companies is the badness of the track—a common fault in America; and

a third loss is the high interest of the debentures, 6 per cent.

The operating expenses of the Atlanta Traction Company are no less than 89·6 per cent., of receipts, a proportion altogether too high for paying results; but all this may be simply a result of over-building. The experience now gathered together in America is very great, but we question if the price has not been too high that has been paid for the experience. The success of the overhead wire has, of course, with permission to use it, been the ruling cause in tramway extension on electrical lines, and it may well prove after all, when we have accepted the overhead system as inevitable, that it has lost half its objectionable features, and electric haulage in England may set out from the first on sound lines, and free from the complication of experimental fads and too great diversity of equipment.

In America, without any traffic in sight to pay, tramways are put down in hopes of expectation of an immediate future traffic, and this too frequently does not arrive, and the line passes into a receiver's hands, and may or may not recover. One of the Atlanta lines running out 15 miles from the city to the Chattahooche River is an example of this policy. At present cars only run on a 30-minute schedule from 6 a.m. to 8 p.m., accomplishing the round trip of 18 miles (for only a length of 9 miles is now worked) in two hours. There can only be thus four cars running at one time, and the worst grade is 7 per cent., or, with curve resistance added, 10 per cent. Yet the equipment is housed in a station 100 feet × by 60 feet, containing three 200-H.P. boilers, and two 18 inches × 44 inches Corliss engines, at 90 revolutions. It is not stated that one is spare.

Now a rated boiler capacity of 600 H.P. looks large. An ordinary horse does not exert more than about $\frac{3}{4}$rds of a horse-power, or, say, about as much as ought to appear at the car motor from each I.H.P. of the engines. How would the four cars look with 150 horses to each. Even if one boiler alone be worked, this implies a capacity of 50 H.P. for each car at work. But particulars are lacking as to these points.

## THE INCANDESCENCE LAMP.*

By A. BAINVILLE.

*(Continued from page 190.)*

The mercury pumps now used in lamp factories belong to two very distinct classes.

1. The exhaustion or air pumps.

2. The pumps based on the employment of the barometric vacuum.

Although the pumps belonging to this last category are older, we will first describe the air pumps, which are more generally used and which were the first to be used in the lamp industry.

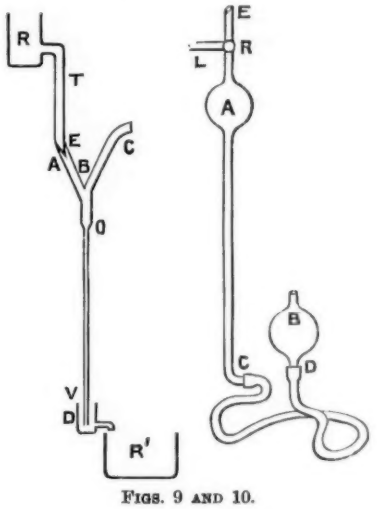
1. *Exhaustion Pumps or Mercury Air Pumps.*—The type of this class is the pump invented by Sprengel in 1865; it is based upon the same principle as the water pump. The working of the apparatus is extremely simple.

This pump consists essentially (fig. 9) of a straight tube of small diameter, O D, the length of which is somewhat greater than that of the barometric column. This tube is placed vertically; it is open at both ends, having at the top a kind of fork, A B C. The whole apparatus is of glass. A receiver, R, containing mercury is connected to the branch, A B, of the fork by a tube, T, and the mercury can thus run into O D by virtue of its own weight. The mercury passes into the branch, A B, through the small orifice in a little funnel, E, so that it is only received at B in the form of minute drops.

If the branch, B C, is connected to the lamps to be exhausted, for instance, by means of a perfectly air-tight pipe, the mercury passing into B D will carry along with it the air contained in the lamps. At the end of a period, which is longer or shorter according to the capacity of the lamps, the vacuum will be obtained. The mercury is thus flowing constantly through the tube, B D, from the upper receiver, R, into the vessel, V, and then into another, R′.

We must, therefore, from time to time renew the mercury in the upper receiver, R, from the lower vessel, R′, so as to prevent any cessation in the flow.

The Sprengel pump, such as we have just described, was employed at the commencement of the incandescence lamp manufacture. We can easily understand that such an apparatus is not of much value for industrial purposes, and, moreover, it only gives a very imperfect vacuum. The




Figs. 9 and 10.

manipulation of the mercury, besides being very tedious, causes rapid poisoning among the workmen; thus the first improvement effected was to raise the mercury mechanically. Then several pumps were connected so as to be worked by the same mechanical power. In order to increase the power of the pump, and at the same time to reduce the time occupied by the operation, the idea was conceived of adapting to each pump several vertical tubes or pipes, such as O D (fig. 9). The addition of these tubes had also the effect of producing a better vacuum, owing to certain peculiarities, of which we shall speak presently. Lastly, the employment of auxiliary mechanical pumps to produce the first vacuum, *i.e.*, to withdraw the greater mass of air, the work of the Sprengel pump being only used for the completion of this vacuum, has rendered the operation much more practical and more suited to industrial applications.

We will now describe the practical conditions of working of a Sprengel pump.

The mercury, as we have said, flows continuously. The quantity passing into the tube at each moment must also be constant; now, as this quantity is determined on the one hand by the height of the mercury above the orifice through which it passes, and on the other hand by the diameter of this orifice, we will assume for a moment that it varies; what will then happen? If it is greater than that of the corresponding tube, the mercury will not pass away, but will soon fill the tube as far as O (fig. 9), and the exhaustion of the air will be stopped until the accumulation of mercury at B O becomes so great that the resulting pressure will impart to the column of mercury sufficient speed to clear the tube. In this case the work of the pump will only be effected intermittently. If the discharge from the funnel, E, is less than that of the tube, O D, the drops of mercury will not have time to collect in sufficient quantity to form a piston in the tube, in which case the pump will not do any work.

We see, then, that the flow of mercury must always be in proportion to the diameter of the tube. We will suppose that our pump possesses this quality which is indispensable to its good working, and we will watch it at work. At the commencement of the operation, when the capacity to be emptied contains air at the atmospheric pressure, the flow is pretty rapid and the column of mercury in the tube is broken into little sections, enclosing between them large bubbles of air. As the pressure diminishes, the bubbles of air become smaller, and the flow becomes slower; this last

* *L'Electricien.*

phenomenon is owing to the fact that the friction of the drops of mercury against the sides of the tubes has increased as the length of these drops increased, and that besides this the column of mercury tends to rise higher and higher in the tube to counteract the external pressure; in fact if we stop the flow of mercury at this point we shall see that this column keeps at a height approximate to that of the barometric column. Soon after the air bubbles become so small that they no longer fill the tube and are thrown against the sides, thus being interposed between the sides and the mercury so that they are carried away with great difficulty. From this moment the mercury falls freely without meeting air in sufficient quantities to impede its fall; the mercury is then said to strike, and, moreover, a sound is then heard which is all the more marked as the vacuum becomes more perfect. It must not, however, be concluded at this point that the vacuum is as perfect as it can be made; the pump must continue to work for a long time before this maximum is attained; the last remnants of air are far the most difficult to remove on account of their remarkable adherence both to the sides of the lamp and to those of the pump. The air drawn out escapes through the bottom of the tube into the mercury in which its extremity is immersed.

An industrial installation of Sprengel pumps consists of a series of pumps, each having a certain number of tubes (from three to six for practical purposes) branched between two pipes, one of which (the upper one) supplies them with the mercury, whilst the other receives the mercury after it has passed through them. The upper pipe has as many elbow joints as the installation has pumps; each elbow joint is furnished with a tap which enables the supply of mercury to be regulated; the lower pipe has an equal number of elbow joints, but without taps. In order to draw up the mercury from the lower receiver, into which the lower pipe empties itself, into the upper receiver from which the distribution pipe is supplied, various methods are employed. The Archimedian screw is often used, or chains with cups; this last is a very bad arrangement, for, as we shall see presently, it is of great importance to keep the mercury from contact with the air.

A better plan is to use an ordinary raising pump; this should be of iron, or better still, of soft steel; by this plan, only the surface of the mercury in the two receivers is directly in contact with the air, and thus the oxidation is considerably reduced. Compressed air can also be used for this purpose. Lastly, if the installation is arranged so as to use mechanical pumps for making the first vacuum, these same pumps might be employed for raising the mercury. In this case, as in the preceding one, the pipes may be suppressed, each pump having its own reservoir of mercury.

The forms given by lamp manufacturers to the Sprengel pump are extremely varied; we will not here enter into the description of these models, we will only mention the various precautions which it is necessary to take in order to attain good results.

In the first place, the mercury should not be accepted unless it is very pure and very dry, hence the necessity of keeping it as far as possible from contact with the air, and in all cases, of purifying it from time to time; the least trace of oxide, and above all of foreign metal, renders its employment absolutely impossible, as it then attaches itself to the glass and cannot slip through the tubes. Care must also be taken not to introduce the slightest moisture, for it is very difficult to get rid of it, and the tension of aqueous vapour renders impracticable the operation of forming a vacuum. The lamps after being blown, contain aqueous vapour in an appreciable quantity; they must be carefully freed from it before being placed on the pumps, and a receiver should be interposed between the pump and the lamps, containing phosphorus anhydride, in order completely to dry the interior atmosphere of the apparatus.

When all these precautions have been taken, the installation is started. If the pumps are well regulated, they will act individually like the one of which we have described the working. We will suppose that we arrive at the moment when the mercury begins to strike. After a few moments of working, during which we have perceived no flow of air-bubbles, we will send the current into our lamps, but only so as to bring the filaments to a dull red heat. Soon we shall observe the re-appearance of the air-bubbles; these bubbles are generally caused by the air adhering to the sides of the bulb which the heating of the filament produced by the passage of the current succeeds in detaching. If this fresh liberation of air is somewhat rapid, we will stop the current for a moment. When these bubbles are no longer formed, the lamp is turned on a little more, the tubes being attentively observed so that the current may be interrupted if there is occasion. Thus, little by little, the normal temperature of the lamp is attained. At this moment, especially if the calcination of the filaments is not perfect, there is a fresh production of bubbles, the formation of which is probably due to the completion of the calcination, and also to imprisoned gases. Sometimes, however, when the fixing of the filament to its support is effected with carbon paste, the liberation of air may proceed from gases enclosed during the process, or from the evaporation of the hydro-carbons that have been used in making this paste. Thus, sending the current into the lamp, in which the vacuum is being formed, is of considerable importance, and must be kept up a certain time to allow time for the various phenomena that we have described to manifest themselves.

We must here mention a drawback inseparable from the Sprengel pump, viz, the breaking of the tubes after a period that is often very short. This breaking is due to the falling of the mercury from the time when it begins to strike; it thus occurs always at a certain moment, but the glass is generally ground away before it breaks, and this breakage is seldom sudden. It is, however, none the less necessary that the workman charged with the manipulation of the pump should watch his tubes attentively, for, when the breakage occurs at the moment when the current is sent into the lamps they are generally rendered unfit for service. Another curious agent of destruction in these pumps is the production of static discharges within the apparatus at the place where the flow of mercury is originated. This phenomenon, which seems to be due to a sort of electrification of the mercury, can be avoided by placing the corresponding portion of the pump in communication with the earth.

The connection of the lamps to be exhausted with the pumps was formerly made with India-rubber tubes. Now the portion of tubing that the glass blower has placed on the bulb is fused directly on to the pump. This is performed on a special tube having as many elbow joints as it is required to connect lamps with the pump; for this purpose the employé uses a little blow pipe with a very tiny flame. The pump being closed he applies the tube of the lamp to that of the pump; he heats the two extremities in contact with his blow pipe sufficiently to soften them; the two edges unite, and, the air of the lamp expanding in consequence of the slight heating caused by the fusion, a perfect joint is obtained. When the vacuum is arrived at in the lamp, he detaches it from the pump with the same blow pipe; he has only to heat the narrow part of the lamp tube and to draw it out as soon as the glass is softened. There is no danger of the air penetrating into the bulb whilst the glass is soft, seeing that the pressure of the atmosphere then tends constantly to close the lamp.

2. *Pumps Based on the Employment of the Barometric Vacuum.*—The idea of making a pneumatic machine based on the barometric vacuum is a very old one. It has been put in practice by various instrument makers, and especially by Geissler, about 1857. The idea is a seductive one, for the barometric vacuum is much more perfect than that which is obtained with a piston working in the body of a pump.

The Geissler pump may be considered the type of this class. It is shown in fig. 10.

Two receivers, A and B, almost equal in capacity, are connected by a tube, A C D, the portion, A C, of this tube is of glass, and its length somewhat exceeds the height of the barometric column; the portion, C D, is of India-rubber. Thus the vessel, B, is movable, and may be raised or lowered. A is surmounted by a tube, having at its extremity a tap turning in three directions, R. The tube, R E, discharges into the atmosphere, and R L is connected with the enclosure in which the vacuum is to be made.

The working of the apparatus is very simple. We fill with dry, pure mercury, the lower receiver, B, open the three-way tap so that it connects the vessel, A, with the atmosphere by R E, and we raise B. The mercury then flows from B into the tube A C driving the air before it; we continue to raise B so as to completely fill A, and we close the tap, R, so that the capacity, A, is insulated. If at this moment we

lower B until A is completely emptied of mercury, it is evident that, if our tap closes well, we shall have produced at A a barometric vacuum. The tap, R, being then opened in the direction of the tube R L, the air contained in the capacity to be emptied expands and fills A. By closing the communication with the tube R L we insulate a volume of this air equal to that in the bulb, A. On proceeding as described above, *i.e.*, on again turning the tap in the direction, R E, we throw back this volume of air into the atmosphere. We can easily understand that we have only to repeat this operation a certain number of times in order to reduce the pressure of air in the receiver to be emptied to as small a quantity as possible. Care must be taken, when the air is driven out of the vessel, A, to compress it beforehand by raising B, so that the pressure shall be at least equal to the atmospheric pressure. The tap, R, must be constructed in a special manner. An ordinary three-way tap would not allow of a sufficiently complete vacuum, in consequence of the space formed by the internal construction of the tap. In the Geissler pumps the holes made in the key of the tap do not meet; one is perpendicular to the axis of the key, whereas the other is bent back so as to take the direction of this axis, as can be seen by fig. 11. In this way not even the smallest quantity of air can be imprisoned in the tap.

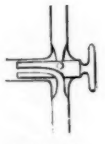


FIG. 11.

The apparatus just described gives a more perfect vacuum and works more quickly than the Sprengel pump of the original type; but its manipulation is very delicate, especially when the vacuum is very far advanced. The receiver, B, must then be raised very slowly, or the mercury will be thrown against the tap and break it, and the level of the mercury in B must be almost at the height of the tap, R, before this latter is opened, or air will be let into the apparatus; when, on the contrary, it is desired to put A in communication with the capacity to be exhausted, the receiver, B, must be lowered until the level of the mercury contained in it is at a distance from A, equal to the barometric height, or the mercury would be sent into the lamps that are being exhausted.

This pump has undergone various modifications. The three-way tap was first suppressed, its manipulation being impossible in industrial applications. The Toepler model is particularly good and gives excellent results. Then the manipulation by hand of the vessel, B, has been replaced by mechanical power, such as the action of compressed air or the vacuum.

Several lamp factories are now provided with pumps of this type and obtain excellent results from them. The precautions to be observed in their manipulation are the same as those enumerated with regard to the Sprengel pump, and the work of soldering and detaching the lamps is performed in a similar manner.

*(To be continued.)*

## THE PROGRESS OF ELECTRIC TRACTION IN GERMANY.

THE Allgemeine Elektricitats Gesellschaft, of Berlin, has just issued an extremely interesting and handsomely printed book of 167 pages, with the title, "Electric Street Railways with Overhead Conductors."

This publication contains a full, illustrated description of ten important roads which have already been equipped by this company, prefaced by a short treatise on the installation and working of electric tramways, and a statement of the traction work in hand.

These ten roads, built in the past four years, have an aggregate length of 90 miles of track, operate 392 cars, and employ 4,395 steam I.H.P. Seven more lines are under equipment by the company, the contracts for which call for the construction of 31 miles of elevated conductors, and the supply of 101 motor cars.

On all these lines, a pressure of 500 volts is used, following the standard American practice. With the sole exception of Great Britain there is no country which does not now allow of the employment of this, or a higher, voltage. The English requirement, limiting the pressure to 300 volts, is an unnecessary impediment to electric tramway installation, forcing a greatly increased investment in copper conductors, with no possible advantage in the direction of securing public safety.

The ten roads described in the book have been electrically equipped at an expenditure of £600,000.

The oldest installation is that at Halle, opened as an electric line in 1891. The working costs of this line are given very fully, and we quote them :—

| | |
|---|---|
| Number of motor cars ... ... ... ... | 36 |
| „ „ trail cars ... ... ... ... | 13 |
| Total miles of track ... ... ... ... | 10 |
| Maximum gradient ... ... ... ... ... | 1 in 20 |
| I.H.P. of engines at power house ... ... ... | 400 |
| Passengers carried in 1893 ... ... ... ... | 3,150,000 |
| Car miles run from June, 1892, to June, 1893 | 695,005 |
| Total receipts for financial year 1892-93 ... ... | £13,552 |
| „ expenses „ „ „ ... | £7,990 |
| Depreciation ... ... ... ... ... ... | £1,500 |
| Sinking fund ... ... ... ... ... | £650 |
| Operating expenses per car mile ... ... ... | 2·79d. |
| Total cost per car mile ... ... ... ... | 3·51d. |
| „ receipts per car mile ... ... ... ... | 4·64d. |

The working expenses were sub-divided as follows :—

| | |
|---|---|
| Transportation expenses per car mile ... ... | 1·23d. |
| Motive power ... ... ... ... ... ... | 0·79d. |
| Maintenance ... ... ... ... ... ... | 0·19d. |
| General expenses ... ... ... ... ... | 0·58d. |
| Total operating expenses per car mile ... ... | 2·79d. |
| Ratio of operating expenses to receipts ... ... | 59 % |

Statistics are given to show that while the horse tramways of Berlin record one accident to the person for every 41,625 car miles run, the Halle line has had but one accident for every 88,638 car miles.

These comparative figures as to the safety of electric traction, are, by-the-way, amply borne out by the results attained in America. The electric lines of the City of Brooklyn, carried 83,196,302 passengers in 1893, with a total list of casualities of 41. From these, eight deaths resulted, none of which were passengers.

Attention is called to the fact that in Halle, the monthly receipts of the electric cars have shown a steady increase, while the horse-car lines show a steadily decreasing business.

The Gera tramway (6½ track miles, 34 cars), which is also described, is especially interesting from the fact that although in its permanent way construction the metre gauge was employed, the ordinary railway freight waggons are carried over the tram-lines by the use of specially designed trucks, and delivered directly on sidings running into the factories of the town, thus greatly aiding in handling goods.

At Gera, the electric tramway power plant is utilised to light the town electrically. The dynamos used have a pressure of 275 volts. For railway work, two are placed in series, and for lighting, one of these dynamos is in parallel with a battery of 132 accumulator cells, from the centre of which the third conductor is taken, the lighting being done on the three-wire system. The following figures are given for 1892 and 1893 :—

| | 1892. | 1893. |
|---|---|---|
| Car miles run ... ... ... | 379,335 ... | 381,857 |
| Working expenses per car mile | 2·97d. ... | 2·80d. |

The electric line at Kiew (8¾ track miles, 32 cars), the first Russian installation of electric traction, is noticeable on account of the heavy grades operated, 1 in 10 being of frequent occurrence.

At Breslau (16¾ track miles, 80 cars), where the line is fairly level, the maximum grade being 1 in 40, the coal consumption per car mile is 4·63 lbs., an exceedingly satisfactory result.

In the old town of Lubeck, one of the historic free ports of Germany, 44 electric cars are operated over 8½ miles of track. The handsome photographic reproductions of the

Lubeck line, show that a trolley wire system has been installed in the streets of this most picturesque of cities, without in any way detracting from their artistic interest.

At Essen, 13½ track miles and 41 cars are in operation. The tramway threads its way through streets which are but 11 feet 8 inches wide from curb to curb, and only 13 feet 4 inches wide between house fronts. The other lines described as in operation and using the Allgemeine Company's plant are :—

| | | | |
|---|---|---|---|
| Chemnitz ... ... ... | 13 miles of track, | 48 | cars. |
| Christiania ... ... | 4⅜ " " | 18 | " |
| Dortmund ... ... | 7 " " | 46 | " |

The following are under construction :—

| | | | |
|---|---|---|---|
| Plauen, i., V. ... ... | 3½ track miles, | 9 | cars. |
| Spandau ... ... ... | 7¼ " " | 24 | " |
| Altenburg ... ... | 2¾ " " | 7 | " |
| Genoa ... ... ... | 12 " " | 45 | " |
| Konigsberg, i. R. ... | 3½ " " | 8 | " |
| Christiania extension ... | — " " | 4 | " |
| Dortmund " ... | 1½ " " | 4 | " |

The permanent way corresponds closely to the best English practice ; grooved rails and a concrete or broken stone bed being employed.

Silicon-bronze trolley wire is used instead of the hard-drawn copper wire universally adopted by American lines. This is probably due to the fact that European wire-makers have not yet produced a copper wire of sufficiently high conductivity and tensile strength.

The devices shown for line-suspension and insulation, and for aerial branching points, &c., do not compare favourably with those used by either English or American electric lines. They seem unnecessarily heavy and large.

In the design of motor-trucks, American practice has been closely followed. One or two, 15 or 25 H.P., single-reduction, armour-clad motors are carried by each truck. Speed-regulation is effected by the use of the series-parallel system, now universally adopted as the best modern practice. If we are not mistaken, this system was first proposed and long advocated by the late Anthony Reckenzaun.

The Allgemeine Company has evidently little faith in accumulators or conduit, and urges the employment of the trolley-system as the only one which has yet shown practical evidence of its ability to satisfactorily fill the requirements of tramway service. No small space is devoted to a summary of the difficulties which have been met with in the attempt to operate tramcars either by storage or sub-surface conductors.

Our Berlin friends are to be congratulated, not only on the enterprise and energy they have shown in developing their traction plant, but also on the interesting publication which is before us.

## DISTRIBUTION OF LIGHT FROM ARC LAMPS.

By RANKIN KENNEDY.

The light is thrown out from the arc in a continuous current circuit, principally in the form of a cone having its apex at the arc and its base on the ground ; this is a favourable circumstance, and is taken advantage of to the fullest extent in street lighting by arc lamps.

For interior illumination the lower carbon is made, sometimes the positive carbon, and the cone of light thrown up on to a white ceiling, or a white disc above the lamp, a method first used at the 1880 Paris Exhibition by Jasper, in lighting the Art Gallery.

An arrangement by Siemens & Halske for the same purpose consists of a diffuser hung over an ordinary lamp. This diffuser is like a reflector in shape, and is about 3 feet 6 inches or 4 feet in diameter at the mouth, and is white painted inside ; it is shown at D, in fig. 1.

A bowl-shaped reflector, or, in other words, a common enamelled iron bowl, white inside, L, is hung below the lamp and serves the double purpose, reflecting light up into the diffuser and receiving any ash or carbon falling from the arc.

Such an arrangement is so far quite old, and is used in photographic electric lamps by Gwynne.

But a new and interesting addition for street lighting is shown at G, a ring of polished glass of triangular section. This ring receives the most intense cone of light from the arc, and deflects it on to the white surface of the diffuser, as shown by the

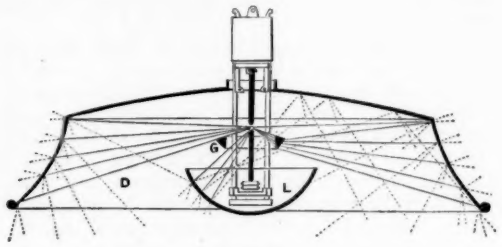



Fig. 1.

divergent lines ; with this arrangement a beautifully uniform illumination is produced. The lamp, of course, must be a focussing lamp ; the glass ring is best built up of four or six segments of glass held in a light metal frame ; the diffuser is umbrella shaped and made of canvas on a wire frame, and painted inside with lead white. The whole arrangement is light and cheap and easily applied to any focussing lamp.

An arrangement like this is far more rational and superior to the insane practice of using semi-opaque globes over arcs in street lighting ; these simply cut off from 30 to 60 per cent. of the light produced, and do not in any way assist the diffusion or distribution of the light. It can never be accepted as good sense to generate at great expense a powerful light of, say, 600 candle-power, and then to carefully cut off 200 candle-power of it in absolute waste, yet that is what is done in every arc lamp with a semi-opaque globe on it.

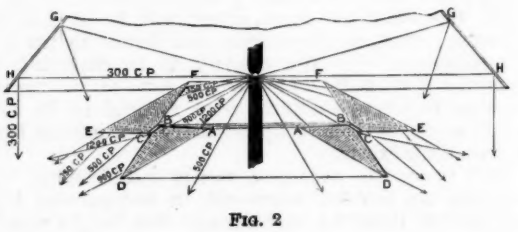
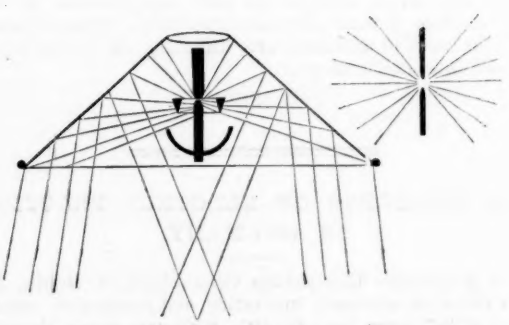



Fig. 2

In this arrangement (fig. 1) the arc is about 8 or 9 inches from the upper surface of the diffuser, which is, altogether, about 18 inches deep.



Figs. 3 and 3a.

Prof. Anthony, who is a prominent authority on arc lighting in America, proposes another scheme for distributing light from arcs.

Fig. 2 illustrates his method : two rings of glass, A B C, D E F, of cross-section, shown fixed with the arc on the level of the upper edge, H, G. H, G is a reflector above

the arc, which receives the upward thrown light and sends it to light up the space immediately below the arc. By means of the prisms the strongest rays are sent furthest off, as will be seen by following the path of the 1,200 C.P. ray in fig. 2.

This is rather an elaborate arrangement, but still as it would give at least four times more light, evenly distributed, compared with the semi-opaque globe, it may be cheaper in the end to use it.

The idea is not to waste about half of the light in an endeavour to soften it, but to screen off the actual light and diffuse or reflect it from a large white surface.

An alternating current arc requires a very different form of rings of glass, and also a different form of diffusing surface. A plain cone is best for this purpose, as the light is thrown from the alternating arc in a diverging ring as in 3*a*.

The usual arrangements of large diffusers are very hideous looking affairs, but where arc lighting is to be adopted on any large scale it is easy enough to make them both effective and artistic with the aid of the architect.

## ELECTRIC STORAGE BATTERY COMPANY'S STATEMENT.

The following special dispatch to the *Western Electrician* from the Electric Storage Battery Company, of Philadelphia, explains that corporation's position in the legal controversy over the accumulator, now being conducted in the United States Court:—

"In view of the publicity given to Judge Lacombe's recent decision in the case of the Accumulator Company *v.* the Edison Electric Illuminating Company, of New York City, directed against our chloride accumulator, and based upon the Swan re-issued letters patent, which expires May 24th, 1895, we deem a statement of facts necessary that our customers and the public generally may not be deceived or tricked into withholding orders from us through fear of litigation, or into buying the batteries of the Accumulator Company and the Consolidated Electric Storage Company, in the belief that they cannot procure and use, with perfect safety, our chloride accumulators, which we are manufacturing and selling under an absolute guarantee to protect and save harmless all users.

"This company has not been enjoined from either manufacturing, selling, or using its well known chloride accumulators, nor has anyone been enjoined from purchasing or using them. The Edison Electric Illuminating Company, of New York, has been enjoined by Judge Lacombe from installing our chloride accumulators as a part of its central station plant simply to maintain the *status quo*, pending the hearing and determination of the case in the Circuit Court of Appeals, upon the contention that the Edison Electric Illuminating Company, having simply contracted for our accumulators, and not yet having actually installed them, should not be permitted to do so until the questions involved in the litigation should be finally determined in the United States Circuit Court of Appeals, especially as an appeal could be at once taken to and heard in that Court on October 30th, and an early decision had thereon; and that was the view taken by Judge Lacombe, and upon which he acted.

"Judge Lacombe's injunction has no other effect or significance, and in no way affects this company's business of manufacturing and selling chloride accumulators, or of their use by purchasers, and was conditioned upon the Accumulator Company giving to the Edison Electric Illuminating Company, of New York, a bond in the sum of $20,000 to make good any loss which it should sustain resulting from the delay in installing our accumulators, should the decision of the Circuit Court of Appeals be in favour of the Edison Company, which we are advised and believe will be the certain result of our appeal to that effect.

"We are advised by our counsel and experts, among them Prof. Charles F. Chandler, of the School of Mines, Columbia College, Prof. George F. Barker, of the University of Pennsylvania, Prof. Edwin J. Houston, president of the American Institute of Electrical Engineers, and Prof. Arthur E. Kennelly, of the Medico-Chirurgical College of Philadelphia, that our chloride accumulator is not an infringement of any letters patent owned by either the Accumulator Company or the Consolidated Electric Storage Company, and that in their opinion the Swan re-issued letters patent are invalid, and expired with the expiration of the Swan Danish patent in 1888; defences which could not be availed of by us in opposition to the motion for preliminary injunction before Judge Lacombe, they having been previously passed upon by Judge Coxe in a former decision in the same Court in the case of the Accumulator Company *v.* the New York and Harlem Railroad Company for the use of the so-called Julien battery, which battery was made in exact accordance with the plate of the Swan re-issued letters patent, and in which our chloride battery was not involved. Judge Lacombe held that on a motion for a preliminary injunction, Judge Coxe's opinion was controlling, and must prevail until the consideration of the case in the Circuit Court of Appeals, when those defences would be fully heard and determined for the first time, as in the case wherein Judge Coxe sustained the Swan re-issued letters patent no appeal was taken, an agreement having been made between the Consolidated Electric Storage Company, who was defending that case, and the Accumulator Company shortly after that decision.

"The facts are these, from which any intelligent person can draw his own conclusion: In December, 1890, this accumulator company brought suit against us in the United States Circuit Court for the district of New Jersey, in which we appeared and made answer, and thereafter, and down to the fall of 1893, no attempt was made to press the case, when it was finally abandoned, owing to our positively declining to further extend the time, and demanding that the case proceed to trial. The Swan re-issued letters patent, upon which alone Judge Lacombe's injunction is based, was at that time owned by the Accumulator Company, although they did not include it in that suit, nor did they after abandoning the suit make any claim against our plate until August last, when the Edison Electric Illuminating Company of New York selected our battery for central station for use in preference to any other battery in the world. Then, instead of bringing suit against us, they brought suit in New York against the Edison Electric Illuminating Company, and applied for an injunction to force a temporary delay in the installation of a battery under our contract with that company. The work of preparing for the installation is going on, and will be completed in time to instal the battery upon the decision of the Circuit Court of Appeals, which we are confident will be favourable to us, and may be expected early in November. Swan's United States patent was applied for January 18th, 1882, and was based upon an English patent to Swan of May 24th, 1881, which expires May 24th, 1895, at which time the United States letters patent will also expire, so this much-talked-of suit is based upon a patent which will expire in about seven months, and obviously was brought for no other purpose than annoyance.

"There is no occasion for anyone to be annoyed or intimidated by threats of litigation from the makers of these inferior and condemned batteries, for we shall continue to manufacture the chloride accumulators, and furnish them under an absolute guaranty to all who require the best battery for all purposes now manufactured, and when the Accumulator Company wants to enjoin us, they will have no difficulty in finding us, no more than did the Consolidated Electric Storage Company, who brought a suit against this company in January last in the United States Circuit Court for the district of New Jersey, accompanied with a motion for injunction, which, after full preparation, was heard at great length before Judge Green, and resulted in an opinion denying the motion for injunction, which opinion speaks for itself, having heretofore been published in the columns of this journal. Since then that suit has been dismissed.

"We are ready at all times to fight out any supposed charge of infringement that either the Accumulator Company or the Consolidated Electric Storage Company thinks they have against us, but we object to their proceeding against our customers, which obviously is for the sole purpose of annoyance and intimidation—methods which reputable business men would not countenance. Let them proceed directly against us, when, if they get an injunction, it will be of some value to them, and the public will not be

annoyed. All suits which they have heretofore brought against this company have been abandoned.

"We say to our customers, and those contemplating the purchase of storage batteries, not to be intimidated or influenced by any threats of litigation, or any such public announcements as have been made based upon the above-explained decision of Judge Lacombe, as this company will stand between its customers and these attacks."

## SOUTHPORT ELECTRIC LIGHTING.

The starting of the supply of electric current by the Corporation of Southport formed part of the proceedings on Mayor's day, November 9th, and the illumination of the Town Hall, the Cambridge Hall, and the gardens in front, formed a fitting termination to the usual festivities incident to such an occasion. The election of mayor took place at twelve; at half-past one there was a luncheon in the Town Hall; at three, the company adjourned to the electric light works to see the engines started; at five, they returned to the Town Hall to tea, and at six the Mayor, taking his place on the steps of the Town Hall, switched on the several circuits till the public buildings and grounds were very prettily illuminated. Then several bands performed, and a glee party sang on the balcony of the Cambridge Hall, the night being quite clear, and thousands of spectators being attracted to the spot. Some interesting details were given at the works prior to starting the machinery, by Alderman Hacking, chairman of the Electricity Committee. He stated that the present scheme had been carried out as arranged by Mr. George Wilkinson (who had to retire through a breakdown in health), except that economical considerations had led to the laying of a single cable instead of a dual one as designed by him. The estimated outlay, so far, is £13,000, which seems a moderate amount for the excellent plant provided. The present installation has a capacity for about 4,200 8-C.P. lamps—the Council themselves are customers for 1,445—and there are 3,586 connected and applied for, making a total of 5,031, so that already there is a necessity for extension. He spoke as if conscious of a feeling among residents who were crying out for the electric light, that the committee were resisting their wishes, and as if he were afraid that the supply of electricity tended to damage the gas estate of the borough. Mr. Siemens, however, who made a few interesting and encouraging remarks both as regards supplier and consumer, called attention to the well-known fact that wherever the supply of electric current has been introduced, there has been an increase rather than a decrease in the demand for gas. It is time, therefore, that this fearfulness on the part of Corporations owning gasworks, should cease. The municipal buildings have been excellently fitted up by Messrs. B. Verity & Sons, who, we understand, completed the whole of the work in about three weeks—a very smart piece of business considering what had to be done in the time.

## CYANIDE AND ELECTROLYTIC CYANIDE SOLUTIONS.

By EMILE ANDREOLI.

The following article was written and was in type before the beginning of the lawsuit which the Cassel Gold Extracting Company has just lost.

I was the first in 1890 and 1891 to contest the validity of the MacArthur and Forrest patents, and to publish articles showing that the action of cyanide of potassium on gold as a solvent was not a discovery and was known to miners, metallurgists, chemists, and electricians, and I may add that the facts I then brought before the public were the very same which were discussed in the course of the celebrated legal proceedings taken by the owners of the cyanide sham monopoly.

Some years ago, a German scientist, Dr. Mitscherlich, having discovered a new process for making wood pulp, made a great fortune, by making all the manufacturers of the world pay him a heavy royalty for the use of his invention. But, it was found, one day, that Dr. Mitscherlich had not discovered anything at all, that his process was known and had been used years before him by an unknown man called Tilghmann; and the manufacturers, who for so long a time had been paying Mitscherlich tribute, took proceedings against him, and having shown that he had obtained large sums of money under the pretence that his process was his discovery, had the legitimate satisfaction of having him condemned to reimburse all the money he had received in the shape of royalties.

A similar case of revolt of royalty payers against their tyrants has just taken place in the Transvaal, where the gold mine owners not having succeeded in their attempt to obtain a reduction of the royalties they had to pay to the Mac Arthur and Forrest Company, took an action to have the MacArthur and Forrest patents cancelled in consequence of possible anteriorities.

At first it seems of little consequence or interest to the readers of the Electrical Review to discuss whether MacArthur and Forrest did or did not discover that cyanide of potassium dissolves gold; but it must be remembered that the name of cyanide of potassium is associated with the first experiment on electroplating by Rnoltz and Elkington; then cyanide of potassium has been used in electrical amalgamators, and the recovery of gold from its ores by means of the electrolysis of a cyanide of potassium solution has been the object of many experiments, not only in laboratories, but on practical scale, and will one day, no doubt, be generally adopted in the mining districts.

The service of eminent lawyers and counsels have been engaged to fight this big case, the importance of which can be guessed from this fact, that in the Transvaal alone, thousands of tons of gold ores are treated every month by the cyanide of potassium process. The magnitude of gold extracting increases every day, and the Randt may very soon produce more than 1,000,000 ounces of gold per annum.

Cyanide of potassium had never been used in the recovery of gold on such a large scale as since 1888 by the MacArthur-Forrest Company; but the properties of cyanide of potassium as a solvent of gold were known since many years by chemists, metallurgists and electro-chemists. Miners have their prejudices, they are conservative and not particularly fond of progress.

After the lamentable adventure of the Cassel process, we were favoured with the curious spectacle of a company who had no process to work, but with plenty of money to do it. This company tried to improve the useless process which they had patented throughout all the world, and in 1886 Mr. J. B. Hannay combined cyanide of potassium with chlorine evolved by electrolysis, as in what is known as the Cassel process.

Very soon after, the Cassel Company secured the patent rights of MacArthur and Forrest and worked them. At last the Cassel Company had a workable process! and they had it tried in many mining districts, and showed in doing it, the same indomitable perseverance of which they had manifested such striking proofs since the failure of the Cassel process.

The results were satisfactory, so satisfactory indeed that almost everywhere where gold is, cyanide will be used, and the MacArthur-Forrest Company claimed its use as their own property. This end of the 19th century is an age of monopoly, and monopoly must be killed in the bud in all cases where it is an unfair encroachment on the rights of the public.

Let us see if Messrs. MacArthur and Forrest have really discovered the solvent properties of cyanide of potassium on metal, free milling, and refractory, auriferous gold ores. I will not argue, but simply state facts and quote extracts of patents and text-books, showing that, unless MM. MacArthur and Forrest never read a book on chemistry, they ought to have known that cyanide of potassium had been used before to dissolve gold and to recover it from its ores.

Prince Bagration in 1844, in Petersburg, delivered a lecture on the action of cyanide and ferro-cyanide of potassium on gold (*Bulletin Scientifique, Petersbourg*, 1844, col.

136, 138), but he was speaking of precipitated gold only which was dissolved by a cyanide solution.

The following extract from a paper by Dr. Hahn is worth noting :—

"Von Cyankalium wird nicht bloss Schwefelkupfer gelöst sondern auch Schwefelgold und Schwefelsilber und by längeren Digestion mit starker Cyankalium lösung auch Schwefelzink und Schwefeleisen."

"Not only sulphide of copper but also sulphide of gold or of silver is dissolved by cyanide of potassium, and sulphide of zinc or of iron is also dissolved by a longer digestion in a strong cyanide of potassium solution." (*Verhalten der Schwefelmetalle gegen Cyankalium. Zeitschrift für Analytische Körper*, 1873, T. xii., p. 441.)

The statements by Dr. Hahn have a considerable importance, and I must quote another one, which, although almost identical with the former, shows that what he said more than twenty years ago about the treatment of gold and silver sulphides by cyanide of potassium, referred not to laboratory experiments but to practical applications of cyanide of potassium to the recovery of gold or silver from refractory ores :—

"Cyankalium ist nicht nur für silber, kupfer, &c., ein gutes Lösungmittel sondern auch fur mehren Schwefelungen; so, lösen sich Cu S (bereits bekannt) Au S und Ag S, Zn S und Fe S bei einigen macerizen in starker Cyankaliumlösung."

"Cyanide of potassium is not only a good agent for dissolving silver, copper, &c., it also dissolves several sulphides; thus Cu S (already known) *Au S and Ag S, Zn S and Fe S are dissolved by a few macerations in strong solutions of cyanide of potassium.*"

A few lines further Hahn says :—

"Ein Erz das 4·869 Ag als Schwefelung enthielt wurde 3 tage mit starker Cyankalium lösung macerirt; der ausgewaschene Rückstand enthielt 0·485 Ag."

"An ore which contained 4·869 Ag as sulphide was macerated for 3 days in a strong cyanide of potassium solution. The washed residue contained 0·485 Ag."

His last remark refers to sulphide of gold :—

"Hinsichtlich der Au S, will ich noch erwähnen dass seine löslichkeit in Cyankalium bereits praktische verwendung hat bei der Gewinrung des Goldes in Californian gefunden."

"With regard to the Au S, I will, however, mention the fact that *its solubility in cyanide of potassium has found a practical application for the recovery of gold in California.*" (*Berg und Hütten Zeitung*, 1870, p. 66.)

Justice Romer's decision has cleared the way, and swept away the fallacious claims of the Cassel Gold Extracting Company to a monopoly. "There is no real invention," he said, "in the MacArthur and Forrest so-called discovery."

The process worked by the defendants was electrolytical; and, therefore, very little being known on the electrolysis of auriferous ores in a cyanide of potassium solution, it would have been of great value to know the views and the opinions of such competent authorities as Dr. G. Gore, Roscoe, Crookes, Lord Kelvin, &c., on the action of the electric current on a mass of ore in a cyanide of potassium solution. But very little that was good was said. There were some vague abstract sentences, theoretical notions, and talk *in nubibus*, but nothing to the point, and the funniest part is that the experiments mentioned by the illustrious witnesses were not made according to the process of the defendants, or were not even made on auriferous ores. Under such circumstances, what is the value of the evidence of the scientists who evidently do not know the advantages and the drawbacks, the dangers, and also the superiority of the electrolysis of refractory ores.

I will not mention any names; I will merely quote some remarkable extracts of the statements which seemed to be the expression of truth on the cyanide process itself, and of the electrolysis of gold bearing ores in a cyanide of potassium solution.

"Before this patent, cyanide of potassium had never been used for commercial purposes."

"There is nothing in common between Rae's method and that of the defendants, but, in each case the ore was placed in a solution of potassium, and in each case the electric current passed through the ore and through the solution."

"It was not common knowledge to me that cyanide of potassium was effective for dissolving gold from its ore."

"An operation which would dissolve gold might be ineffectual when applied to gold and its ore. [In Rae's patent there were two electrodes, and the electrodes in the first tank had nothing to do with the solution of the gold by the cyanide of potassium.]"

"In the plan shown to me the anodes and cathodes were at a certain point, and these had an electric current of less than two volts. The electricity thus produced would retard the action of solution. I had not experimented on this particular bath, but would expect to find the deposit on the cathode."

"A retarding effect was the result of the experiment. With the cyanide of potassium used with the anode and cathode, the anode having the gold, the gold would, by the solution, be deposited on the cathode."

"In Faraday's disclosures with regard to gold leaf, the relation of area to mass was of great importance. Faraday's specification would not lead anybody to the practical process of dissolving gold out of ore by that solution. Nobody could predicate that the dissolving action would be such as to be of any use."

"The gold upon which I experimented was in a different condition from that in which it exists in gold ore, and was not, therefore, trustworthy for the purposes for which it was put forward. The gold I used in the electric bath was smelted, but not annealed. The liquid could pass from one tank to the other. I did not test whether in its passage it had deteriorated. If it had I felt sure that the deterioration would have remained on one side. Polarisation would protect the metal from the current going through it. Agitation of the liquid in the experiment I made would not have altered that result. The gold was not in the same state as it would be in the ore. In the experiment the gold was not so small as it would be in the crushed ore."

"The specifications alleged to be anticipations did not disclose the use of cyanide of potassium for the extraction of gold from its ore."

"I was present at the experiments made in the case, but they never took the defendants' actual apparatus for the purpose."

"The solvency of gold was generally known years before, but not of gold in ore."

"The discovery of MacArthur and Forrest was that what was known to scientific men (namely, that a solution of cyanide of potassium would melt gold), was enlarged to apply to gold-bearing ores practically. The merit of the plaintiffs' invention was the application of a scientific fact to practical use, showing that what was known in the laboratory, and had only been done on a small scale, could be applied on a large scale, and practically, to gold-bearing ores. In my opinion, it was a patent to cover every solution of cyanide for the treatment of every kind of ore. Without modifications it could not be so well applied to gold ore where there was much copper."

"In my opinion, Rae's specification did not point to the fact that Rae knew that gold was soluble in cyanide of potassium without the aid of electricity."

"In the alleged anticipating specifications there was no case in which the cyanide of potassium alone was used for the purposes of extraction."

"I never knew gold dissolved directly in cyanide of potassium for the purpose of forming a solution. Electricity was used in connection with electroplating."

"Looking at Rae's patent, there was a cathode on which there should be a deposit. Rae might think he got the deposit through the current. In Pielsticker there was an electrical deposition, and the leaf of gold was suspended between the two terminals in the jar. A considerable portion of the current would pass through the gold. If the gold was in the ore, a much smaller portion of electricity would pass through. Assuming the gold leaf to be dissolved by the current, that would be in the solution; if

time enough were given it would ultimately be on the cathode."

Thus the cause of public interest has been victorious, and the monopoly of the owners of the cyanide patents has been upset. But such legal actions, it is sad to have to remark it, are not made to increase the prestige of the savants who gave the support of their name, and of their influence to the Cassel Gold Extracting Company, and who affirmed in a most solemn manner that it was not previously known that gold was dissolved in cyanide of potassium.

What a slap in the face of all the men who came forward, declaring that the discoverers of the dissolving action of cyanide of potassium were something like the benefactors of the gold industry!

Have we placed the men of science so high in our admiration, in our veneration, on a throne, to soar over the vulgar interests of material life, to see them descending from the height of fame and stooping to play the rôle of witnesses in a legal case, which ends by a verdict condemning their protégés and showing that they did not know anything about the subject, that they were wrong in their statements, and that their evidence was not the expression of the true and real facts?

Napoleon said that he could make counts, dukes, or princes, but that it was not in his power to make a Corneille or a Newton. Saint Simon used to say that an emperor, a king, a prince may die, but that there is at once a prince, a king, or an emperor to take their place, but that when a great artist, a great writer, or a great scientist dies, it is a loss for humanity.

*Noblesse oblige.* Scientists are the pride of their country; they represent the highest aristocracy on earth, and we deplore to see them mixed in such legal fights where, not only their grandeur diminishes and their *aureole* disappears, but where they play a sorry part, since the decision of the judge gives them the lie, and, instead of protesting, they have to keep silent.

## REVIEWS.

*Elementary Magnetism and Electricity.* By Clement J. Leaper, F.C.S. London: George Gill & Sons, 13, Warwick Lane, E.C.

The book before us is one of Gill's "Science Series" now being compiled under the editorship of Mr. J. J. Pilley, to meet the new conditions of the Science and Art Department. It is divided into four parts named respectively, "Electricity in Curvilinear Motion or Magnetism"; "Electricity at Rest or Electrostatics"; "Electricity in Rectilinear Motion or Electro-kinetics"; and "Electricity in Curvilinear Motion or Electro-magnetism." It will thus be seen that all the phenomena are referred to electricity as the cause of their being. Magnetism is thus merely a phase or manifestation of electricity in curvilinear motion, since every molecule of a magnetic body is encompassed—as indeed, according to the author, is every molecule of all bodies—by a constantly moving circular current, "and as a result each atom (of every substance, be it observed), is a complete magnet." This is simply the well-worn Ampèrian theory revived and driven far beyond its utmost legitimate limits. There is nothing wrong with the theory as a theory, provided that by its means a reasonable and satisfactory explanation of the various phenomena observed can be given. This is exactly what cannot be done, and is, therefore, where the theory, as a workable basis and not as a mere abstract conception, fails. Take this, for example: At page 268 the author says "What we have provisionally called" (in treating of magnetism) "rotating the poles of each atom, is now seen to mean rotating the current already circulating around each atom." If this is so, how does the author explain the lengthening of a bar of soft iron under a magnetising stress?

In treating of electrostatics, again, the author's theory is that electricity is an entity, and that every body in its natural state contains a fixed and unalterable quantity of it. Bodies, however, may possess more or less electricity than the natural quantity. "We may therefore define a charged body as one which contains more or less than its proper share of electricity. We *assume*, of course, that it is the positively charged body which contains more, and that it is the negatively charged body which contains less . . . ." Now it is really subversive of the meanings usually associated with words, to use the word "charge" as the author does. How can one *charge* a body by taking away what it contains? If Mr. Leaper means to be consistent and to stick to his theory, he will require to carry it to its logical conclusion and invent a vocabulary to suit. The author's desire to be concise (in conjunction with his announced theories) leads him into crudities of expression which at first sight appear ludicrous. Thus in one place he says "The inductivity of that insulator means the degree to which a charge *will expand its bags*." This has a reference to the elastic bags of electricity which hypothetically encompass the atoms of every substance, and not to an article of attire which has been exclusively associated, *hitherto*, with the male sex. Of course, the author has to treat of the repulsion which exists between similarly charged bodies, as, for example, the gold leaves of an electroscope. Why it is, however, that repulsion occurs when the electricity happens to be in excess or defect, and does not occur when the same electricity is present in just (what is supposed to be) its proper quantity, the author does not attempt, as far as we can see, to explain. To this extent, therefore, he fails to make his book a useful and reliable guide for study. Many of the explanations he does attempt, too, of some of the more striking phenomena, are either obscure, by reason of their over-conciseness, or are not in accordance with observation. Such, for example, are his ways of accounting for the fact that statical charges are always found on the surface when equilibrium exists; and also his explanation of the induction of currents. In the latter case one would be led to understand from the mode of illustration adopted that the induced current would persist so long as the primary circuit was active, independently altogether of any change in their relative conditions.

The book on the whole is very well arranged and written, the language especially being clear and forcible. The different points taken up are classified under numbered articles, each of which has a separate heading. A large number of experiments (some of which, by the way, are not of very great use) are described, the size of type used being smaller than that employed for the text. The letterpress is well and clearly executed, and is almost entirely free from blemishes; but the illustrations, which, in such a book ought to be a matter of first importance, are decidedly poor. We cannot help thinking that it would have been better if those referred to in the preface as belonging to the Messrs. Gill, and perhaps some of the others also, had remained in their cases. It really is high time that many of these relics of a by-gone age were enshrined in museums. The figures supplied by the author are distinct enough, but sadly lack finish.

A list of questions is appended to each chapter, and, at the end, the last two examination papers of the Science and Art Department. A useful little glossary of terms and a very complete index are also given.

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*Tables and Memoranda for Electrical Engineers.* By Frederick Walker, C.E. London: Iliffe and Son, 3, St. Bride Street, E.C.

This is a little book of thirty pages, consisting of tables and formulæ such as are likely to be of use to electrical men. Amongst the tables are: diameter and cross area of wires according to the Birmingham gauge; length, resistance, and weight of pure copper wire; gradients; electrical H.P.; and hours of lighting. A few of the commoner formulæ are also given. We cannot see, however, that there is any advantage in possessing such a scrappy little book, since no electrical engineer could get along solely with its help. He would require his Munro and Jamieson, or some other fuller compilation in any event. Between every two leaves there is bound a blank sheet, on which the owner of the book may jot down whatever else, not given here, is likely to be of use to him. To be of any real service whatever, the whole of these blank leaves would require to be filled. The only advantage that we can see which this book possesses, as a pocket book, is that it takes up but very little room in the pocket. This we can vouch for.

*The Repair and Maintenance of Machinery.* By Thomas Walter Barber. London: E. & F. N. Spon.

For a volume supposed to deal with the repair and maintenance of machinery, there is a good deal herein contained that might as well have been omitted; such information, for example, as appears in the circulars of any gas engine manufacturer need hardly have been repeated, nor do we see any special call for the insertion of a table of pump diameters and gallons of capacity. This sort of information is good enough in its own way and very proper for insertion in the pages of a pocket book, but has nothing to do with the repairing of machinery. Indeed, such a table is scarcely needed when a couple of lines would have contained the formula — diameter$^3$ = pounds per yard, and, by adding a decimal point, = gallons. Thus a 10-inch pump barrel holds 10 gallons in each yard of length. The chapter on pumps is simply a brief description of pumps by various makers with external views of the same of no value. Nearly four pages are given to the pulsometer, yet the intention of the book only occupies two lines with the perfectly true statement that the valves are the only parts likely to need occasional repairs and *need no special mention*. Why then fill four pages with a description and illustration of a pulsometer? In the chapter on turbines, the table of horse-powers and water used has a familiar appearance as though bodily lifted from an American catalogue, which illustration, fig. 226, would seem to be.

The best chapter in the book is that on boilers and their faults. In this we really find something said about the wear and tear of boilers and the means taken to repair them.

Next in merit is the chapter on steam engines; but the book as a whole is distinctly disappointing, being rather a series of chapters descriptive of prime movers, pumps, mill gearing, and other appliances, teaching rather how they should be designed rather than how they should be repaired. So far as the correctness of the information given, the accuracy of the tables, and the truth of the teaching is concerned, we do not notice in glancing through the book anything to condemn, but we were not asked to this book at all. The title invited us to a book on the maintenance and repair of machinery, and we had hoped to have found something on shop methods, hints on smithwork, shop "dodges," and makeshifts, such as must be employed for jobs that fall outside the dimensions of the shop tools, but there is none of this, and we confess to a feeling of disappointment, for the bulk of the information we already have on our shelves between the covers of various pocket books and trade catalogues. The aim of the book is, perhaps, too ambitious. The author finding he could not write it to represent its title, has simply collected a lot of information and pieced it up with a rehash of already published works and a few platitudes. Though we have said there is nothing specially to condemn, we would add that a great deal is told that is supposed to be known to anyone for whom the book is intended. Thus we are told the pipes of a hydraulic riveter must be prevented from freezing. So we should have supposed.

It is perhaps doubtful whether it is possible to write much of a book on repairing. This is so essentially a matter of experience that it can neither be learned from nor taught by books. Indeed, repairing work, dirty and disagreeable as it often is, is the finest school a young mechanical engineer can enter if he would get a true insight into mechanical design, for it is amongst worn things, and not with new material that he will see the weak points, and learn best what to avoid in his own designs.

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*The Telephone Hand-book.* By Herbert Laws Webb (*Electrician* Publishing Company, Chicago, Ill., U.S.A.).

This, in the words of the preface, is a "little book." *Multum in parvo* would have been very appropriate on its title page, for though small in bulk it has much in it. Glancing at the illustrations, we feared at first that the author had adopted the almost invariable custom of recording the numerous modifications of Bell's invention, to which the modifiers have given their names, but we are glad to note that he has confined himself to noticing those which are "typical of some form of construction or special device offering certain advantages," and has devoted his attention principally to the description, illustration, and elucidation of instruments and exchange systems which are in actual use by practical telephonists. The descriptions of apparatus are not limited to a catalogue of parts, but explain functions; the illustrations are sometimes minute, but invariably clear, and the elucidations, though not provokingly elementary, omit no feature which is necessary to a proper understanding of the subject. Anyone interested in telephony would peruse the handbook with profit and pleasure, and would take care to have it handy for occasional reference.

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*Tellustria: A Method of Determining Astronomically the Variations in the Temperature and Pressure of the Atmosphere.* By B. G. Jenkins, F.R.A.S. London: R. Morgan, 65, Westow Street, Norwood, S.E.

The author's method consists in determining the relation which subsists between the variation in the distance of the earth from the sun from day to day and the probable proportionate change or disturbance in the earth's atmosphere. He finds that the logarithmic differences of the distance of the earth from the sun, in combination with similar differences for the distance of the moon, gives a resultant curve which has a striking resemblance to the curves of thermometric and barometric readings. Where the curves did not agree it was found that there was a distinct inversion in almost all cases. The author does not attempt to gloss over any discrepancies, nor to argue that his theory has yet been fully developed, but he argues, with good reason, that there is a sufficiently close accordance in the results to make it highly probable that the arguments are sound. The plotted curves are decidedly interesting and significant.

## CORRESPONDENCE.

### The Incandescent Gas Light.

Pressure of business has prevented me from replying sooner to your strictures on the Incandescent Gas Light system from a hygienic part of point, and in fairness I trust that you will now let me have space in your Journal to reply to your criticism. You based your argument upon the report made by Mons. Grehant, and upon the interpretation given to this report by *La Lumière Electrique*. I would, however, point out that Mons. Grehant made two separate communications on the matter of the products of combustion from the Welsbach light. In the first he stated that he had found carbonic oxide to the amount of 1 part in 4,300. The date of this communication was July 9th, 1894. In the second he proves, by the actual test on a living subject, that the small amount of carbonic oxide thus involved is perfectly harmless, his own words being: "Je conclus de cette expérience que l'emploi d'un bec Auer ne peut pas produire d'empoisonment."

It is needless to analyse the motives which govern the electrical organs in making this partial quotation, but the want of fairness in so doing is obvious, as, to those who are not in a position to ascertain the truth by personal investigation, the reports in question are most misleading.

It would have been more honest if, in quoting the results of Mons. Grehant's experiments, they had quoted also his deductions from these experiments, instead of giving their own, which were at variance with the facts. Certain considerations throw some doubt on the scientific accuracy of Mons. Grehant's methods of testing for carbonic oxide, and, therefore, on the value of the results obtained. His method ascribing any carbon found in the products of combustion (after absorption of all the carbonic acid), necessarily and solely to the presence of carbonic oxide, does not carry conviction, as it is quite possible that carbon may have existed in the products of combustion in traces of unburnt hydro-carbons, and more especially if it happened that the gas supply was imperfectly adjusted to the mantle. Also, it is possible to conceive, in the absence of information as to the precise method of collecting the products of combustion from the mantle, that the device adopted may have produced a local cooling, which would result in less perfect combustion than in the case of a burner entirely uninterfered with.

Even assuming that Mons. Grehant's methods and results

are correct, the hygienic question is not so much—what is the percentage of carbonic oxide in the products of combustion? as—what proportion would be found in the atmosphere of an ordinary dwelling room in which a Welsbach incandescent gas light burner is used?

Assuming that the products were collected directly from the mantle, there would be about 33 cubic feet per hour, and since, according to Mons. Grehant, $\frac{1}{4300}$th part of this consists of carbonic oxide, this would give the amount of carbonic oxide passed into the room as $\frac{1}{130}$th cubic foot per hour. Thus, in a dwelling room of 2,000 cubic feet capacity, the air of which is ordinarily renewed completely by ventilation, &c., about once every hour, there would certainly never be found more than $\frac{1}{260000}$th part of carbonic oxide. So small a proportion would tax the skill of an analyst to discover.

As a corroboration of Mons. Grehant's statement that the products of the Welsbach burner are practically *harmless*, I would quote Mons. Lange, who, in a communication to L'Ecole des Arts et Metiers de Lubeck, states that the substitution of the Welsbach light for ordinary gas reduces the vitiation of the air.

Further, Prof. Renk, the Director of the Hygienic Institute of the University of Halle, states that the products of *incomplete* combustion in a Welsbach burner are *nil* or unappreciable, and that lighting by incandescent gas constitutes a progress in the science of illumination of which the bearing is immense from the point of view of health.

In addition, I may mention that Prof. Bosshard, on an analysis of the atmosphere of a room of 70 cubic metres' capacity, after six hours' burning of a Welsbach lamp failed to find even the slightest trace of *carbonic acid* in 100 litres of air taken in the neighbourhood of the burner.

I do not think it necessary to quote any further authorities, as those I have given are amply sufficient to refute the prejudiced and misleading statements made by the too zealous advocates of a rival system of lighting. I cannot, however, complain of the results of this unfair attack upon the incandescent gas light system, as any investigations into this system only result in increasing its popularity, and in confirming the good opinion of the public.

**L. de Fonblanque,**

*Secretary Incandescent Gas Light Company, Limited.*

*November 9th*, 1894.

[It seems to us that M. Fonblanque rather gives himself away by his questionable logic. If there is any doubt about the accuracy of M. Grehant's tests, why should his second communication be considered *proven* by M. Fonblanque while he utterly rejects the first? Perhaps, however, it is needless to analyse the motives which govern the worthy secretary in making the partial quotation, &c.!

Again, on the assumption that M. Grehant *is* correct, M. Fonblanque argues that the hygienic question is not so much a matter of what percentage of carbonic oxide is in the products of combustion, as what proportion would be found in the atmosphere of an ordinary dwelling room. To us it seems that that proportion would depend upon the percentage of carbonic oxide. If little, the proportion in the atmosphere would be little; if great, the proportion would be accordingly large; if none at all, then none can form a proportion of the atmosphere.

As an American exchange says:—"It should not be forgotten that it is the same old gas, that the light remains a naked light, and that the results of combustion remain just as deleterious and poisonous as ever."

Then the New York journal, quoting portions of our leaderette which has brought forth M. Fonblanque's reply, goes on:—

"This is interesting, and may be supplemented by the following authentic data:—

| Illuminant. | Cubic feet of carbonic gas produced. | Cubic feet of air vitiated. | Heat evolved in lbs. of water raised to 16° F. |
|---|---|---|---|
| Electric light ... ... ... | None. | None. | 13¾ |
| Common gas ... ... ... | 3¼ | 348¼ | 278½ |
| Paraffin oil... ... ... ... | 4½ | 484 | 362 |
| Wax candles ... .. ... | 6 | 632¼ | 383 |

"It follows that not only is the combustion of gas hurtful to human beings, but that books, furniture, tapestry, carpets, decorations, &c., are all injured. In most of these respects the use of the Welsbach burner makes no difference, except to inhance the harm done."

Finally, our contemporary suggests that to meet the extravagant claims of the Welsbach light, incandescent electric lamps of high efficiency should be used, and here we agree, because the superiority of the Welsbach is based on ordinary 16-C.P. electric lamps, which we may at once tell M. Fonblanque is neither fair nor just to the capabilities of electric lighting. He must bring forward scientific facts, and not mere assertions, if his arguments are to have any weight. —Eds. Elec. Rev.]

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### Regulation of Pressure on Supply Mains.

Mr. Grimshaw corroborates your remarks about the miserable state of affairs in our public supply systems so far as regulating of the pressure on the mains—or, rather, should we say, want of regulation on the mains—goes.

British electrical engineers may hang their heads with shame at such admissions. Is it really impossible to provide for a variation of 100 ampères or more? What has become of the storage battery as a regulator? How can the pressure fall where a proper battery is used? Where, and oh! where, have our compound windings gone? We are now just beginning to get indisputable evidence of the kind of engineering foisted upon the public during the introduction of the first municipal plants. The antics of the poor managers left in charge to keep up the delusions are simply ludicrous.

**Rankin Kennedy.**

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### Experientia Docet.

There is a sect of religious people whose creed is popularly expressed by the saying, "once in grace always in grace," and it would appear that Mr. Medhurst holds somewhat similar views on general questions. Once a photographer, an editor, a sweep, or a parson, and you must not pretend to anything else. In my young days I was many things. "Everything by turns and nothing long" was applied to me in scathing rebuke by my kindly relatives, whose only fear for me, or care of me, was lest I should appear tattered and forlorn upon their particular doorstep, to disgrace the high standing of the family. Though I have never been a parson, or even a photographer, I have come very near to being a sweep, and actually have, on more than one occasion, occupied the position of editor. What else I have been would too long a tale unfold, but it has never occurred to me to question the fact that a very wide and multifarious experience, even in positions the least remunerative, or such as may place a man in very strange surroundings, such as the fo'ksle of a steamer or on the Wallaby, does not disqualify a man for any other position for which he may have a sufficient intelligence and aptitude. Hence I think it very ill-judged and ill-natured of Mr. Medhurst to endeavour to discredit another man who has once done something otherwise than what he now undertakes. Is it not playing it rather low, and do we not in England sometimes carry things a little too far?

George Stephenson, like your present correspondent, once shovelled coals, and this shut him out of the Institution of Civil Engineers. It would not have shut him out of the kindred society in America. A celebrated novelist recently found himself a guest at a house in America, where he once acted as stableman. A man who, at the time, was occupying the position of head of an important Government department in a leading colony, once heard of a friend who was, *pro tem* acting as stoker on a steamer calling at the port, and he not only went aboard to see his old friend, but took his wife with him, and, moreover, got leave off for his friend and housed him for a night. While aboard of the ship he recognised in one of the quartermasters a man who had been quartermaster of a ship on which he himself had once occupied a position less enviable than that of quartermaster. The quondam stoker is now chief engineer in some London works, and very frequently acts as adviser on special technical matters to leading engineers. Does Mr. Medhurst yet

clearly recognise the fact that he is born? Can it be possible that he thinks we are all set going in our youth in the way we should go, and that we do not in older age depart therefrom?

The smartest managing engineer I know sold half sacks of flour to old women on the hillsides and out-of-way villages of the North of England, until Providence kindly intervened, and forcibly changed the current of his life; and so we might go on bringing up case on case to illustrate the ludicrous position taken by Mr. Medhurst. It would do him good to occupy a few years like many others of us as a

Λαας κυλινδων.

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### Armature Calculations.

Having evolved some formulæ for easing the troubles of the designer of dynamos, I submit them to you for criticism. Having an Elwell-Parker, an Edison, and two Crompton dynamos under my supervision, I have made calculations which show that in these four machines (which work well and without spark), the density of field is 40,000 lines per square inch. Such a density produces over-saturation of the armature core in a ring armature, unless the radial depth of the core is excessive, but the freedom from sparking and field distortion fully compensates for the slightly increased magnetic reluctance of the core. Taking it for granted that 40,000 is the right density, the area A of the pole-piece covering the armature, can be expressed by the formula,

$$A = 60 \frac{K}{n D},$$

where K represents the output in watts, and $n$ the revolutions per minute, while D is the diameter of the armature in inches.

To apply this formula, let the watts be 5,000, *i.e.*, the dynamo is to run 100 lamps of 16 C.P., the diameter of the armature is taken to be 6 inches, while the speed is fixed at 1,200 revolutions.

$$A = 60 \frac{5{,}000}{1{,}200 \cdot 6''} = 42 \text{ square inches.}$$

As the pole-pieces usually cover one-third of the circumference of the armature, the length, L, can easily be found:

$$L = \frac{A}{D} = \frac{42}{6} = 7 \text{ inches.}$$

Thus the area of each pole piece would be 42 square inches, and the armature would be 7 inches × 6 inches.

In small machines it will be found that 60 is too small a constant, and the formula must be written

$$A = 60 \frac{K}{n D} \left(1 + \frac{5}{K}\right).$$

**Edward C. Barton.**

Brisbane, Queensland, *October 4th*, 1894.

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### The Magnetic Properties of Asbestos.

As far as I can understand Mr. E. Hancock's last letter, all that his experiments show is that a piece of asbestos card, suspended by a silk thread and statically electrified, behaves like any other similar body under the same conditions.

I do not doubt that this is the case; indeed, it would be surprising were it otherwise, but seeing that in my experiments the asbestos was not suspended, nor insulated, nor electrified, I entirely fail to see what possible bearing Mr. Hancock's investigations in elementary statical electricity have on the subject.

I scarcely think that I should be justified in further occupying your valuable space in endeavouring to convince Mr. Hancock of his error, but I may say that if he has not been able to detect very distinct magnetic properties in asbestos, he must either have experimented upon a piece of thin material which was quite different from all the numerous samples tested by Mr. Stanton and myself, or, and this is the most likely solution, he must have employed a magnet of insufficient power.

Undoubtedly, as I mentioned in my original communication, a very strong magnet is necessary to show the effect well, but given sufficient power, no one could possibly make the mistake of thinking the action to be electrostatic instead of magnetic, as is undoubtedly the case.

With regard to Dr. L. Bleekrode's interesting letter, is it not possible that the oxide of iron in asbestos is in some peculiar condition or combination that renders it more magnetic than usual? It appears to me that the magnetic qualities are more likely to be due to the iron than to the other elementary constituents of the substance.

**A. A. C. Swinton.**

*November 12th*, 1894.

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### Dynamo Connections.

Will you kindly tell me whether a dynamo, wound as shown on enclosed sketch (shunt coil marked red), is as good for an incandescent circuit as one wound in the ordinary compound manner, and whether the winding has anything to do with the lamps not glowing as they ought to do? The machine is a 100-light one, and would, altering the connections, improve the machine? Thanking you in anticipation,

**Puzzled.**

Manchester, *November 10th*, 1894.

[If the tracing shows the connections as they are actually wound on the machine, the main coil is acting contrary to the shunt coils. If you reverse the connections of the shunt we think you will get free of your difficulty, that is, put the left-hand shunt wire into the right-hand terminal, and the right-hand wire into the left terminal.—Eds. Elec. Rev.]

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### Design of Large Alternators.

I am instructed by my clients, British Thomson-Houston, Limited, to state that their attention has been called to a very serious libel upon them, contained in a letter headed "Design of Large Alternators," signed John S. Raworth, and published in your issue of the 9th inst.

My clients are the contractors who supplied the two alternators referred to in the said letter, and are responsible for the conduct and capability of the machines referred to. The statement that these two alternators were "built to a strict English specification, which was modified at their request to meet the possibilities of their construction, but even with the specification so modified the said alternators do not even approximately comply, notwithstanding that months have been spent in trying to improve them," is absolutely false, as are other statements in the letter referred to.

The said alternators have been running for more than a year, and have never given the slightest trouble, nor have they been altered in the smallest detail, nor have any modifications been contemplated, while my clients have recently received orders for eight additional machines of a similar type for the same central station.

You will, I am sure, appreciate the serious effect that a libel of this nature, published in a paper of such importance and wide circulation as your own, might have upon my clients' business if allowed to pass uncontradicted, especially in the provinces, where people are not so well informed about the matters in question as in London.

My instructions are to include you as defendants in an action for libel, which I am instructed to commence, but I feel that the letter may have appeared through inadvertence on your part, and my clients will be quite willing to take no further steps, so far as your paper is concerned, provided you insert an apology in your next issue. In the event of your failing to consent to this course, there will be no other alternative open to my clients than to commence proceedings against you, and claim substantial damages.

**Henry F. Kite.**

11, Queen Victoria Street, E.C.
*November 14th*, 1894.

[We have much pleasure in publishing the above letter which is an answer to Mr. Raworth's letter which appeared in our last week's issue. We in no way hold ourselves responsible for the opinions expressed by our correspondents, but we regret that we should have published a letter which has caused the British Thomson-Houston, Limited, any annoyance.—Eds. Elec. Rev.]

**Localising High Resistance Faults in Submarine Cables.**

When describing in your Journal of September 7th my application of Lord Kelvin's null method capacity test, as a convenient means of measuring the potential at the end of a cable on board ship, it was not my desire to enter into any lengthy discussion with those who are already quite satisfied with the null method recommended by Prof. Jamieson, but merely to explain for the benefit of others who, like myself, do not consider it a perfectly satisfactory test, a simple method which can be relied on to give very good results, whether using a slide resistance of 100,000 units, or only such resistance as a Wheatstone bridge affords, and without having to use a large number of *standard* cells.

As Messrs. Cruickshank and Scott, of the Glasgow Technical College, have, at Prof. Jamieson's request, been at some trouble to try the method referred to, I shall be glad if you will allow me to make the following comments on the results they arrived at :—

On the subject of measuring the potentials, P and $p$, *on shore* by discharges from a condenser, Messrs. Cruickshank and Scott say :—"We very much preferred the null methods to that of discharges from a condenser." What the resistance of the fault tested was is not given, so that I can only give my counter experience. When dealing with faults of high resistance, say, 10,000 units and upwards, which one is perhaps unable, or, it may be, not permitted for sufficient reasons to break down, and which have in consequence to be localised with a limited number of cells, the potential at the fault, under the stress of the testing current, constantly changes, and unless the potentials, P and $p$, on shore, and $p_1$ on board, are observed at the same instant, results will be obtained very far from correct. As absolute coincidence of observation at the two ends cannot be secured, the next safest thing is to obtain as large a number of readings as is possible in the given time. It is on this account that, on shore, I prefer to waste no time in balancing, but to get a large number of condenser discharges from P and $p$ (especially from the latter, and from the distant end, $p_1$, also, if situated *on shore*), for there is safety in numbers. There will often be certain readings showing that the potential remained for a short time, at any rate, steady, so that one can select these readings with a tolerable degree of confidence, and reject others which clearly show sudden and momentary changes at the fault. By the method which Prof. Jamieson seems so wedded to, changes at the fault make it difficult to obtain a perfect balance under these conditions, and one does not get so large a selection in the given time. Moreover, frequently putting the several points of the cable, even momentarily, to the slide resistance until a balance is obtained, will still further upset the regularity of the "fall."

In the case of a fault of *low resistance*, the "fall" is comparatively steady, and if Messrs. Cruickshank and Scott have been dealing with such a fault, I can understand them not finding any advantage in a number of discharge readings.

With regard to the *condenser null method* employed by me on board ship, Messrs. Cruickshank and Scott find "there can be no doubt that where '*earth*' or '*fault*' *currents* are present, or when very high resistance slides cannot be obtained, the '*null condenser method*' is preferable." This decision in favour of my method I accept with becoming modesty; but when they add, "we found that the *old null method* (Munro and Jamieson, p. 152, and fig. 3, p. 281, Electrical Review) gave results 2 per cent. nearer the actual position of the fault than the *condenser methods* described by Mr. Jones for finding P, $p$ and $p_1$, one would infer that, under some other than the above conditions (given in favour of my condenser null method), a closer result, by 2 per cent., may be counted on when using the so-called *old null method*. Now, considering that the degree of accuracy obtainable in both cases depends on a judicious selection of values to apply to Clark's fall of potential formula, it is not clear how Messrs. Cruickshank and Scott arrive at such a conclusion. It would appear that there must be some inherent weakness in the *principle* of the test, but this Messrs. Cruickshank and Scott do not suggest. On the contrary, it is the *old null method* which, *for high resistance faults*, is weak. I must, therefore, conclude that the discrepancy in the results obtained was either accidental, and that on a repetition of the test the result would just as likely be the other way; or, that it arose from the fact of its being the first time they employed this particular method. Perhaps this will also account for its taking "50 per cent. more time" "to connect up for Mr. Jones's method" than for the old zero method; and yet the connections are only those for Thomson's capacity test, which are familiar to most electricians.

Having been employed on a cable-repairing steamer more or less for the last 22 years, I fully appreciate that economy of time is important, but when time is very precious, the electrician would have the foresight to get his apparatus ready as soon as he became aware of the existence of the fault, and while the *shore* is being instructed, and makes the necessary arrangements for testing.

Messrs. Cruickshank and Scott say: "The time actually taken in making our tests by the two plans was about the same," so that I don't quite understand why so much is made of any slight difference in time for connecting up. As a matter of fact, when laying or repairing a cable it is a practice with me, and I suppose on most cable ships, to have Thomson's (or Gott's) capacity test permanently joined up—not for testing for *faults* but for measuring *capacity*, and thereby arriving at the length of cable in circuit when necessary. But even should there be a difference of a minute or two in connecting up for the test, the more important question should be *which test, under the circumstances referred to, will give the best results*; and, if the *shore station* has no *slides*, or sufficiency of *standard* cells, he may well ask "how am I to get any readings *at all* to compare with those *on board*, unless I employ some such method as that recommended by Mr. Rymer-Jones.

Messrs. Cruickshank and Scott further remark that "the greatest care must be taken in first of all seeing that the condensers do not leak." Yes, that is so, and, I may add, that the galvanometer and other parts of the testing apparatus must be trustworthy, for no one can expect to get reliable results with weak apparatus. I stipulated for *condensers*, and not electrical *sieves*. These gentlemen further say: "We found that no reliable results were obtained when the dielectric of the condensers used were of different materials, and thus had different rates of absorption or electrification." To this I have only to respond: Why not use two ordinary standard condensers, not necessarily of the same capacity, but similarly constructed, and therefore having practically equal rates of absorption?

I pick out from our stock any two condensers in good condition, and meet with none of the unsatisfactory results Messrs. Cruickshank and Scott arrived at when using this test. Besides, even if the rate of absorption be slightly different, this would scarcely affect the result, because, although using the same connections, we are not comparing the condenser with the cable for capacity—in which case the different rate of absorption is, of course, important; but we are merely comparing the E.M.Fs. of two batteries, one of which is represented by the cable; and for this purpose the time of charging and mixing need be very short indeed, as the two potentials are correctly compared by the relative *surface charges* taken up by the two condensers.

To Mr. F. A. Taylor I would reply: Although the ship would probably have *slides*, it frequently happens that neither ship nor shore have more than one or two standard cells, and the shore only a Wheatstone bridge. I don't at all understand what the paragraph about "$p_1$ being a fixed and unalterable quantity" has reference to. Putting the cable end on board to the *slides*, through which the battery of standard cells is circulating, in order to obtain a balance, is very different to comparing a standard cell with the *slide* testing battery, when the precautions specified are observed. I specially mentioned that "on shore any of the known methods are available for comparing the E.M.F. of the standard cell with that of the battery used," and I know no method more safe, or expeditious, than discharge from a condenser. On board, also, the E.M.F. of the standard cell may be compared with the *slide* battery by *condensers* also, in the same way as when measuring the potential, $p_1$, at the end of the cable; but Poggendorff's method may be employed if the precautions specified be observed, and time is pressing, as it is a little more expeditious. Mr. Taylor says "he now admits that for high resistance and varying faults, prolonged readings would be desirable," and certainly I know only too well that, for unsteady faults, *prolonged readings* would be *absolutely necessary*; but then this applies equally to *any* test, if correct results are to be obtained.

I am glad that Mr. Taylor agrees with me that the ordinary marine galvanometer is unsuitable for comparing *throws*.

Thanking you for allowing me to trespass at so great length on your valuable space,

**J. Rymer-Jones.**

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### An Outrage.

Is there any limit to the vagaries of those who invite tenders for electric work? We think not, and to show cause for this opinion, cite the following:—

We recently, in answer to an enquiry from a colliery in the Midlands, sent in a tender for a lighting installation, and soon afterwards received a letter asking us to call to settle a few points in connection with our offer, which apparently was favourable.

On arriving at the colliery, after a journey of 200 miles, followed by a fairly long walk in heavy rain, we found the gentleman (?) whom we had to meet had gone away, but had kindly left word he *might* be back about three hours after the time appointed.

There was nothing for it but to wait as patiently as might be, in which we found we were not alone, there being several other competitors present, who had been summoned from all parts by a man, who, when he did arrive, displayed an ignorance of the elements of any part of the subject he was trying to deal with, the density of which was only equalled by his entire disregard of the value of other people's time, independent of the expense he had involved them in, perfectly unnecessarily, as every question asked was fully and clearly answered in our specification, which apparently he had not troubled to read, or if so, was incapable of understanding.

A great number of tenders had evidently been sent in, some with samples of various kinds, and at very considerable expense, in addition to which everyone had been asked to attend personally, and our friend was clearly under the impression that his course of action in giving this utterly unnecessary further trouble, in a matter which he had not power to settle, was a suitable subject for satisfaction on his part, as indicating some kind of mental capacity and acuteness.

It appears a pity that eccentric individuals of this class cannot be made to pay heavily for such proceedings, evincing as they do an utter absence of the most ordinary business common sense and consideration.

Hoping you will afford an opportunity of ventilating this kind of thing,

**Competitor.**

[Our correspondent, who represents a firm whose reputation is probably known where the English language is spoken, has just cause for complaint, and we trust that his letter may be the means of putting a stop to a practice which, so far as we can learn, seems to be spreading.—Eds. Elec. Rev.]

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### The Engines of the Bolton Electricity Works.

Referring to your number of the Electrical Review dated November 9th, 1894, in which you give an account of the engines that we have put in for the Bolton Electric Lighting Works.

We beg to draw your attention to a remark on page 562, as follows:—Speaking of the engines, you say "they are no doubt excellent specimens in their way, but in some respects they are not altogether what one expects in central stations now-a-days. The principle of the design is excellent, but some of the details of the design do not strike us as being altogether happy."

This remark is calculated to do us injury, and is no doubt the result of a cursory examination of the engines by your representative. He may be a very good engineer, and may have had wide experience of electrical supply work, but we wish to know what you find fault with.

We maintain that the engines are in every way suited to the work they have to do, and to the speeds at which they have to run, and the details have all been carefully worked out to this end. If you can point out to us anything about the engines that unfits them for driving alternators, we shall be very pleased to hear it, if not, we must respectfully request you to withdraw your remarks.

**John and Edw. Wood.**

*November 12th*, 1894.

[We regret that anything we should have said concerning the Bolton Electricity Supply Works should have given offence to Messrs. J. & E. Wood, the makers of the engines. But surely what was said cannot, even by the makers, be considered to amount to a condemnation of the engines. It was not even our intention to damn them with faint praise. We said they were excellent specimens, but did not quite approve of some of the details. They were details, however, which could not affect the general working of the engines. It struck us that the gearing for driving the governors was a little rough, and might cause considerable noise when working. This opinion may be wrong, for we admit that our examination was a most cursory one, and we had not the pleasure of seeing them when running. But even if our opinion on this detail were correct, we should not say that it unfitted them for driving alternators. Indeed, nothing could have been further from our thoughts than to suggest that Messrs. Wood's engines were unfitted for the work for which they were designed. It can be scarcely claimed that we exceeded our functions of journalists when we pointed out what, in our judgment, was a minor defect. It may have been an imaginary defect, but it was honestly come by, and we trust that Messrs. Wood will acquit us of any intention to injure them when we formed an opinion which, by reason of its hastiness, was, perhaps, erroneous.—Eds. Elec. Rev.]

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## LEGAL.

### Wise *v.* The Metropolitan Electric Supply Company, Limited.

In the Chancery Division of the High Courts of Justice, on Friday, before Mr. Justice Stirling, in the action of Wise *v.* The Metropolitan Electric Supply Company, Limited, a motion for leave to issue a writ of sequestration against the company was made by Mr. Graham Hastings, Q.C. (with whom was Mr. E. Beaumont). Mr. Vernon Smith appeared for the defendants.

Mr. Hastings said he had to move on behalf of the plaintiff, that he might be at liberty to sue out a writ of sequestration, directed to commissioners to be therein named, to sequester the goods, chattels, personal estate, and the rents issues and profits of the real estate of the defendants, for contempt of this Court by the defendants wilfully disobeying the order of the Court of April 27th, 1894, whereby the company were perpetually restrained from using the buildings and hereditaments known as South Mews, parish of Marylebone, so as to create a nuisance to the plaintiff or to the occupants of their houses by vibration; and that the costs of this application be paid by the defendants. The operation of the judgment of April 27th had been suspended until July 29th, and subsequently until after September 4th, so that it became operative on September 5th. This application was made under Order 42, Rule 31, which was in effect that any judgment or order against a corporation, wilfully disobeyed, might, by leave of the Court or Judge, be enforced by sequestration. He gathered from some of the affidavits that the defendants would make the point that they had not "wilfully disobeyed;" but he apprehended that wilfully was put into the rule as opposed to inadvertently, so that if the disobedience were inadvertent, the rule would not be enforced. To say in this case that it was not wilful because the defendants did not intend to commit a nuisance, would not do. The Court had found that by the working of their machinery the defendants had created a nuisance; and the working of the machinery was continued, and continued the nuisance. He submitted that that was wilful in the sense in which a corporation must be held to be responsible for their own acts. If that was not the correct view, an injunction could not be enforced at all. The question of fact remained, whether the nuisance had been committed since September 5th, when the order became operative. From the evidence of the plaintiffs and occupants of the houses in Manchester Street, as well as of Prof. Silvanus Thompson and Mr. Walker, his assistant, he would submit that it was plain that the nuisance had been committed. When the defendants applied to have the order suspended until September 5th, they made a point that they proposed to use certain turbines which would do away with the vibration. They ordered three of these turbines from the makers, Messrs. Parsons, Newcastle; but they had only got one, and it was not got into operation until September 17th. They expected another of these turbines on the 12th inst., and the last one at the end of the month. He (Mr. Hastings) need not say that the object of the application was to get rid of the nuisance; and if the Court thought fit to make the order that the writ should issue, he believed that the plaintiffs would not be unwilling that it should not have effect for some reasonable time—say for a fortnight—so as to see whether the company could get these other two turbines into operation. It was not to be forgotten that this notice of motion was given nearly two months ago, and the plaintiffs had since then kept a strict record in each house of the effects of the working of the machinery. Counsel proceeded to read

the evidence of Wise and his tenants, who all spoke to intermittent vibration, sometimes strong sometimes slight, rattling of windows and of china on the walls, shaking of beds and of floors, one witness asserting that the vibration was "dreadful," and another that she had "better be on board a ship."

Mr. Vernon Smith read the evidence on affidavit of Mr. Wingfield, one of the company's engineers, who occupied a room in Wise's house. He deposed that he had never experienced any such vibration in the house as would interfere with the comfort of any resident either by day or night. His brother sometimes stayed with him, and informed him that he never experienced the vibration. The witness had also repeatedly informed his superiors that he had never felt any inconvenience from vibration. Other officers of the company made affidavits detailing the alterations made with the object of stopping the nuisance, and the removal of part of the works elsewhere, and testifying that the operations could not have been more expeditiously carried out. Mr. Walker and Prof. Silvanus Thompson deposed to having made several visits to the houses, and to have found no vibration at all, sometimes, and at others only a very slight one. Lord Kelvin made an affidavit very much to the same purport; and employés of the company gave evidence from a log-book to show that the engines were not working at all at some of the times when the plaintiff's witnesses spoke to having felt the vibration. Mr. Vernon Smith then addressed the Court. He submitted that the company had done everything conceivable to obviate any nuisance. There was now only one reciprocating engine. One turbine was already at work, and two additional ones were to be delivered by the end of this month, and when they were at work there would be no vibration at all, as the engines would be altogether dispensed with. The defendants had used every endeavour, under the most difficult circumstances, to comply with the judgment of the Court; and he contended that the evidence for the plaintiff was not so satisfactory as to induce the Court meantime to deal with the case in the way sought for by this motion.

His Lordship: Are you in a position to say that from now, to the end of the present month, you will be able to do without working more than one engine?

Mr. Vernon Smith: Yes, certainly.

His Lordship said that if the defendant company gave an undertaking to that effect, he would be disposed to direct that the motion stand over for three weeks. If the defendants worked three reciprocating engines, on the evidence as it stood they committed a nuisance; but he was disposed to think, although he could not say he was absolutely satisfied, that if the company worked only one turbine and one reciprocating engine, they would not commit a nuisance. But he would like to be satisfied of that by a further trial, because it was common ground that those vibrations were very eccentric, and the truth was that very eminent men of science, who had given opinions on this case, had expressed those opinions with great uncertainty, and obviously it was a very difficult thing to put right. Therefore, though that was the balance of his opinion on the evidence at the present time, he would like to be satisfied, by further experiments, that that really was the case; and therefore, the company undertaking not to work over this day three weeks, more than one reciprocating engine, but being at liberty to use as many turbines as they pleased, the motion would stand over.

Mr. Vernon Smith gave the required undertaking, and agreed that the plaintiff's engineer should have inspection of the company's works on giving reasonable notice. Thereupon the Court directed that the motion stand over for three weeks.

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## The Cassel Gold Extracting Company *v.* The Cyanide Gold Recovery Syndicate.

### Judgment.

In the Chancery Division of the High Court of Justice, on Thursday, the 8th inst., Mr. Justice Romer delivered judgment in this action, which was tried before him last July. The action, it will be remembered, arose out of an alleged infringement of the plaintiffs' patent by the defendants.

His Lordship said: Since the conclusion of the arguments I have read through the notes of the evidence, and have further considered that evidence, and the different points urged by counsel, and in the result I am confirmed in the opinion that the patent cannot be sustained. The invention claimed in the patent is a very simple one, and the claim very comprehensive. It is for the application of a solution containing cyanogen, so as to dissolve the gold and silver in powdered ores. The gold (for I need not further distinguish the silver) is then to be recovered from the solution by any of the well known ways. The kind of solution to be used as the solvent is described by the specification very broadly. It is to be any solution containing cyanogen, or any cyanide soluble in water (such as cyanide of potassium), or any other substance or compound containing or yielding cyanogen. [See p. 2, lines 15 to 17, and see also lines 34 to 37.] No special application or machinery, or device, or scheme of any kind is required. The solution is simply to be poured on the ore. You may stir the ore about in the solution if expedition is required, or, if you choose, you may let the solution rest, so as gradually to solve the gold in the ore. In fact, the patent really is for an alleged discovery that a solution containing cyanogen can be used to dissolve out the fine gold in powdered ore. Now how did matters stand at the date of this patent? It was perfectly well known that a solution of cyanide of potassium would solve gold in a fine state, and that the finer the gold, the more speedy the process. The peculiar property of cyanogen, that it would solve fine gold if oxygen were present, was well known. The chemist, in his laboratory, knew that by pouring a solution of cyanide of potassium on fine gold he could solve the gold. It is true that in this country no one had commercially used a solution of cyanide of potassium to extract the fine gold in the powdered ore; but this is not surprising, when the following facts are borne in mind: First, that in this country very little gold ore is found at all, and that so far as appears up to the date of this patent, ores were not brought to this country from abroad to have the gold extracted here as a commercial transaction; and secondly, even if the gold in the ore had been extracted, there was no known successful method and paying method of recovering the gold from the solution. It is proved before me that for some time after the date of the plaintiffs' patent the patentees' alleged invention was not commercially worked, because no efficient and paying method was known of recovering the gold, and that it was not until the patentees subsequently made a discovery, which they patented, of a new method for recovering the gold from the solution, that the use of a solution of cyanide of potassium to extract the fine gold in ore was practically employed for commercial purposes. But the matter does not rest here. Not only was the above-mentioned property of cyanide of potassium known, but in 1867 one Rae took out a patent in the United States, and the specification of his invention was published here before the date of the plaintiffs' patent. Rae's invention as there described was *inter alia* for the extraction of the gold from the powdered ore. His process was this: he took a solution suitable to solve the gold from the ore, and he expressly mentions a solution of cyanide of potassium as one that could be employed, and he poured this solution on the ore in a vessel which he agitated by machinery, and he used electricity for two purposes, first, as he expressly says, to facilitate the action of the solution in solving the gold in the ore, and, secondly, to recover it from the solution by depositing it on a certain base in the machine. So that undoubtedly in his specification he recommends the use of cyanide of potassium as a means and for the purpose of solving the gold in the powdered ore. And he was, of course, right in so using it. And I do not see that his recommendation is rendered worthless because he also recommends electricity to facilitate the action of the solution, and also to do some other work with the solution after the gold is extracted. Then again, in 1884 one Simpson took out a patent in the United States, and his specification was published here before the date of the plaintiffs' patent. Simpson's process as described in this specification was substantially identical with the plaintiffs', except that the solution he mentions is one not of cyanide of potassium only, but of a comparatively small quantity of carbonate of ammonia added. Of this addition of carbonate of ammonia the plaintiffs have naturally made the most, but I am satisfied on the evidence that the addition does not substantially affect the operation of the cyanide of potassium on the ore, and that Simpson's solution is perfectly efficacious. Why he added the carbonate of ammonia is not clear. Possibly because it was of use when the ores were what is termed "acid"—possibly because he did not dare, having regard to the existing knowledge, to claim boldy the cyanide alone. But I think a person reading this specification would gather from it that the cyanide of potassium was the main ingredient, and was employed because it was a solvent of the gold in the ore. Under these circumstances, I come to the conclusion that at the date of the plaintiffs' patent, having regard to what was then published and known, there was no real invention in the plaintiffs' so-called discovery. And indeed, when I consider the evidence of Mr. MacArthur as to how he came to make his alleged discovery, what it comes to really is this: That so far as the main alleged invention is concerned, he wanted to find a solution for the gold in the ore, and tried several solvents, and among them he tried cyanide of potassium, which he knew to be a solvent of fine gold, and not unnaturally he found that it answered. There being, in my opinion, no real invention or discovery in the application at the date of the patent of a solution of cyanide of potassium to extract the gold from powdered ore, it follows that on this ground alone the patent must fail. But before I quit this part of the case, I ought to say a word about the expert evidence bearing on it. Several eminent chemists were called on each side, but the two sides did not agree in their evidence, and in the conflict of testimony I am not only at liberty, but am bound to exercise my own judgment, and that judgment agrees with the views of Mr. Riley, Mr. Mactear, and Prof. Attfield, who stated that in their opinion, at the date of this patent, no invention was required to discover that a solution of cyanide of potassium could be practically applied to dissolve gold and silver in crushed ore. But, in addition to the above, I think there is another ground on which this patent is bad. Even if the invention was one which could form the good subject of a patent, I think it was anticipated by Rae's and Simpson's specifications. Test it in this way. If the patent were held valid, would not Rae's and Simpson's processes, if now used according to the specifications published, be liable to be stopped as infringements? I think they certainly would. What chance of escape would a person have who took Rae's, for instance, and used the cyanide of potassium specially mentioned by Rae? It would be said against that person with crushing effect that he was using the cyanide of potassium for the very purpose pointed out in the plaintiffs' patent, viz., to dissolve the gold in the crushed ore, and not the less because he tried to assist the process by the aid of electricity, which might or might not be of any real assistance, and certainly not the less because he used the electricity also for another and for a different purpose. So, also, a person now using Simpson's process would be liable to be stopped. For it would be proved against him that he was using the cyanide of potassium for the very purpose, and in the very way pointed out in the plaintiffs' specification, and that the addition of carbonate of ammonia made no particular difference. To hold that Simpson's was not an anticipation would lead to a strange result. A person using cyanide of potassium alone would be an infringer, but if he chose to add a slight amount of carbonate of ammonia (which is cheap, and practically innocuous), he could not be restrained. This would in itself render the plaintiffs' patent practically valueless. Now as the specifications of Rae and Simpson were published here

before the date of the plaintiffs' patent, all persons in this country are at liberty to use the processes there set forth, and that right is incompatible with those persons being liable, if they do use such processes, to an injunction at the suit of the plaintiffs. For these reasons the action must be dismissed.

The action was accordingly dismissed, and after some discussion, the defendants were given the general costs of the action, and the plaintiffs the costs of the issue of infringement.

[We understand that the plaintiffs forthwith decided to appeal against the above decision.]

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NEWINGTON, PRIDDLE & Co., LTD., *v.* ANDERS TELEPHONE COMPANY.

THIS case having been referred by the Assistant Judge of the Mayor's Court to the Deputy-Registrar on November 1st, came on for hearing on Saturday last. The plaintiffs' claim was for £48 18s. 7d. for making receivers and face plates for the defendants. The defendants set up a counterclaim under three heads: (1) For goods supplied to plaintiffs to the amount of £22 16s. 10d. This claim was admitted by the plaintiffs. (2) For £20 10s. 1d., damages for bad workmanship; (3) For £367 5s., damages in respect of late delivery. Particulars had been obtained of this latter sum, which showed that it included directors' fees, office rent, and establishment charges for four months, during which it was alleged the defendants' business was at a standstill on account of non-arrival of receivers. The learned Registrar after a lengthened hearing, found for the plaintiffs on all points in dispute, and judgment was given for Messrs. Newington Priddle and Co., Limited, for £26 1s. 9d., with the costs of the cause and of the reference. Mr. Patrick H. White was counsel for the plaintiffs, instructed by Mr. C. I. L. Gray.

## BUSINESS NOTICES, &c.

**Universal Electrical Directory (J. A. Berly's).**—Messrs. H. Alabaster, Gatehouse & Co. have now in course of preparation the 1895 edition of this directory, which embraces all connected with the electrical trades throughout the Universe. It is indispensable to all having business transactions in the electrical world. Names and addresses for insertion, corrections, and orders for advertisements should be promptly forwarded.

**Bath.**—On November 5th there was a failure in the supply of the City of Bath Electric Lighting and Engineering Company. The Guy Fawkes carnival was being held that night, and this made the breakdown seem worse than it really was. We understand that the real facts of the case are as follows: There are two circuits of arc lamps for lighting the streets from the station. There are about 42 lamps on each circuit in series, and on one circuit two faults suddenly developed themselves in the cables at the foot of two lamp-posts, after the station had been running about an hour. One fault being on the positive and the other on the negative pole, 16 lamps were cut out. There had been an enormous amount of rain, which is stated to account for the cables giving way. This was the extent of the breakdown. Mr. Gatehouse, the corporation inspector, had, fortunately for the company, tested the cables that morning, and found everything correct. There are very serious floods round Bath now, and the water was nearly up to the ash-pits in the boilers on Tuesday night. In spite of this, however, all the street lights were on just the same, although the water had risen in some cases 4 feet up the lamp posts. The gas lamps were burning very badly all over the town, and at half-past nine they were all extinguished.

**Berlin.**—The directorate of the Berlin General Electricity Company, at the next general meeting of shareholders, will propose a dividend of 9 per cent. The dividend last year was at the rate of 8¼ per cent.

**Birkdale.**—The local board are very dissatisfied with the quality of the gas supplied to them by the Southport Corporation. Several members favour the introduction of electric lighting into the principal districts, but the matter is to be fully discussed in committee.

**Blackburn.**—At a recent meeting of the Gas Committee, Mr. E. M. Lacey, C.E., of London, was appointed consulting electrical engineer to the Corporation during the erection of the electric lighting installation.

**Cardiff.**—At the last meeting of the Council Councillor Good gave notice that at the next meeting he should move for appointment of a special committee to make a searching and impartial investigation into the causes of the "extraordinary and continued vexatious delay in completing the electric lighting of the town."

**Chelsea.**—We hear that Mr. F. H. Cheesewright, of the London Refuse, Steam Generation, and Electrical Power Corporation, has written to the vestry offering to destroy all the parish dustbin and trade refuse for 1s. 6d. per ton. The proposal is now before a committee.

**Chiswick.**—The Local Board have expressed to Messrs. Bourne and Grant their dissatisfaction at the slow progress made with the electric lighting works.

**Coventry.**—The residents have been circularised to the effect that the City Council will be able to supply current for private lighting by about January next. The streets to be supplied first are Broadgate, Smithford Street, Fleet Street, High Street, Earl Street, Jordanwell, Hertford Street, Cross Cheaping, Burges, Hay Lane, Priory Row, Bayley Lane. 6d. per unit is to be charged.

**Copenhagen.**—The free harbour which has been in course of construction at Copenhagen for some years was inaugurated last week. Not only is the harbour lighted by electricity, but all the machinery is also operated by electricity. For this purpose the Allgemeine Electricitäts Gesellschaft of Berlin, who have secured a thirty years' concession for the work, have established a large central station, which at the end of the period named will become the property of the Free Harbour Company.

**Cork.**—In our last issue we referred to the lighting of Donnybrook Fair, held in Cork. We now understand that the show was opened on Tuesday morning, the 30th ult., and remained open till a very late hour on Tuesday night, the 6th inst. In fact the fair, which was held to rebuild the Cork Eye and Ear Hospital, wound up with a ball given by Lady Arnott to the stall holders. The whole of the lighting, which was of a temporary character, was carried out by the Electrical Installation Company, Limited, the premises, which covered the site of the Cork Exhibition of 1885, being handed over to them only a fortnight before the opening of the fair. The plant consisted of two 14 H.P. and one 12 H.P. portable steam engines, two 160 ampère 110-volt dynamos, one 45-ampère 100-volt dynamo, 6 arc lamps, over 600 incandescent lamps of from 16 to 50 candle-power, and over 8 miles of wire and cables. Great difficulty was experienced with the foundations for engines and dynamos, owing to the spongy nature of the soil, the land having been reclaimed from the river bed some years back. The Municipal Buildings themselves are settling to an alarming extent. The lighting, which was carried out under the supervision of Mr. E. L. O'Brien, was admitted on all sides to have been far ahead of any temporary installation yet seen in the Emerald Isle, the light being as steady as if run from a supply station.

**Dundee.**—During October, 769 Board of Trade units of electricity were supplied to the four arc lamps in High Street, at a cost of £16 5s.

**Dunrobin.**—The Duke of Sutherland is having an extensive electric lighting installation put down at Dunrobin Castle.

**Ealing.**—The Local Board last week considered the question of the desirability of retaining in force the resolution come to at the previous meeting, that as application had been made for an extension of the electric light mains to the northern part of the district (Haven Green, Woodville Road and vicinity), if practicable, the board should for the present discontinue the laying of the electric cable along the Uxbridge Road, from the foot of Hanger Lane to the Acton boundary, and use the cable that would have been employed between those points for the introduction of the light over the railway into the Haven Green district. The clerk read a letter from Messrs. Bramwell and Harris, the engineers employed by the board under the electric lighting scheme, stating that they had given instructions in accordance with the wishes of the board in the matter. A member last week asserted that the resolution had not been obeyed, and neither the town clerk or the surveyor could give any explanation of this. After a very lengthy discussion it was decided that the main-laying be proceeded with as originally intended.

**Gainsborough.**—The Albert Theatre is to be supplied with electricity for lighting purposes, a steam engine and dynamo having been installed for the purpose.

**Glasgow.**—The arrangements for lighting the corporation cars by electricity are now completed. The Froggart Electric Lighting Company, Limited, whose system is at present used on Metropolitan trams and 'buses, are the contractors. In each car there are to be four lamps—two inside and two outside—of 8 C.P. On the outside the lights are to be elevated on iron standards from 3 to 4 feet above the level of the roof, and each, in an elliptic glass globe with copper frame, will be in the centre of a disc of about a foot in diameter. At Coplaw Hill and Kinning Park buildings are being erected for dynamos, charging gear, and so forth, and here the accumulators, which are to contain sufficient current for 10 hours, will be recharged, being conveyed afterwards to the different depôts in specially constructed vans.

**Hertford.**—Several of the councillors professing to be influenced by the feelings of the ratepayers, made up their minds to have the resolution adopting the electric lighting scheme, rescinded. Our readers will remember that the casting vote of the chairman carried the resolution. The new councillors and mayor at their very first meeting have rescinded that resolution by 11 votes to 8; so that so far as concerns Hertford there is to be no progress in electric lighting yet awhile, unless some of the councillors are persuaded to take a more reasonable view of the question. The ex-mayor fought vigorously against the rescinding resolution and contended that members interested in the gas company ought not to vote, though this rule was not followed. One of the opponents of the electric lighting said:—"He could not understand how any man of business could be in favour of it. They were asked to risk five or ten thousand pounds to supply electricity at 6d. a unit, when, by the incandescent burners they could get gas now at 1d. a unit." It is a great pity that the scheme which has proved so profitable in other places, should be shelved by ratepayers whose eyes are not opened to the advantages of electric lighting. It is asserted that a meeting of ratepayers which

was held to oppose the scheme was made up principally of individuals interested in the gas company.

The Town Council last week decided not to give their consent to the application of the Great Western Lighting Company for a provisional order.

**Hove.**—The capital expenditure for electric lighting up to December 31st last is stated, by the auditor of the Hove Company, to be £29,236.

**Kendal.**—An Electric Lighting Company having communicated with the Town Council regarding lighting the town, a special meeting of the whole Council is to be held to consider the question, the company to send a representative to attend if they so desire.

**Liverpool.**—The City Council have now appointed a Special Lighting Committee for the purpose of conducting the arrangements for lighting, including electric lighting and the supply of gas to the city, and of executing the powers and provisions of all public and local Acts relating to these matters.

A complimentary dinner was given in the Junior Reform Club last week to the ex-chairman, and also in celebration of the installation of the electric light throughout the building.

**Llandudno.**—The Llandudno Improvement Commissioners, last week, considered a scheme for supplying the town with the electric light. It was resolved that application be made for a provisional order, and a committee of five was appointed.

**London.**—The action of the North-Western Hospital Committee in having engaged the services of Prof. Ayrton to prepare a report on the question of lighting the North-Western Hospital by electricity, and draw up a specification for wiring the hospital and supervising the work, &c., was confirmed by the Metropolitan Asylums Board the other day. The offer of the Hampstead Vestry to supply electrical energy to the hospital at 4d. per Board of Trade unit, was also accepted. It was stated that the committee would shortly advertise for tenders for wiring the hospital.

**Lowestoft.**—A paragraph in the minutes of the General Purposes Committee is somewhat amusing especially at the present moment. Mr. F. H. Medhurst had an interview with the Committee regarding their proposal to introduce electric lighting into the town, and they resolved to communicate with him further shortly. Another consulting electrical engineer (Mr. T. W. Baker) at a later date wrote and offered to visit the town, and give, gratuitously in the first instance, any information they required. Mr. Baker is to be received at the next meeting on November 27th.

**Madrid.**—An important installation has been carried out here by Messrs. Flaquer y Ca, at the Royal Palace. There are 7,000 incandescent lamps, 40 arc lamps, for lighting which there are three 100,000-watt dynamos and three steam engines of 150 H.P.

**Manchester.**—At the annual meeting of the Household Stores Association, last week, the chairman said that during the past 12 months the electric light had been introduced into the whole of the premises at a total cost of £628.

**Milford Haven.**—St. Catherine's Church was lit up with the electric light last Sunday evening. Three arc lamps of 2,000-C.P. each were used.

**Milngavie.**—A Glasgow paper states that on the site of the Old Calico Print Works, ex-Provost Woodburn has erected several tenements, and the shops and houses along Station Road have been fitted up for electric light.

**Oldham.**—The resident engineer has reported that the number of lamps connected up to October 30th was: Arc, 47; incandescent, 1,235, equivalent to 4,328 lamps of 8-candle-power, showing an increase during the fortnight of 552 lamps of 8-candle-power.

**Pontypool.**—The *London Gazette* contains an announcement of the application to be made to the Board of Trade of the Pontypool Electric Light and Power Company, Limited, for a provisional order.

**Portrush.**—The Belfast and Northern Counties Railway Company are making arrangements for the lighting of the Northern Counties Hotel by electricity.

**St. Pancras.**—The Vestry, last week, approved of the scheme of the Electricity Committee for supplying the remainder of the parish with the electric light, the commercial success of which has been proved in the south-west district. The estimated ultimate cost of the entire new works is £48,565. The Committee has been authorised to proceed forthwith with the laying of mains in a large area to be served by the King's Road Station, which is rapidly approaching completion. When these works were originally planned, in July last, it was calculated that the expense would be £28,000, but having regard to the present reduced prices of copper it is anticipated that a saving of £6,000 will be effected in the estimate with respect to this material alone.

**Southampton.**—The head offices of the *Hampshire Independent* and *Southern Echo*, at 52, Above Bar, Southampton, have recently been fitted up with electricity, the current being generated by a dynamo supplied by Messrs. Crompton & Co., who have carried out the whole of the arrangements. The dynamo is driven by a 14-H.P. gas engine. The installation provides for 130 16 and 32-C.P. lamps, in addition to an arc lamp of 300-C.P.

**Telegraphs in Spain.**—A commission has just been appointed in Spain to enquire into the condition of the telegraph system of the country, and the means to be adopted to improve the same.

**Whitechapel.**—The District Board have inquired of the guardians whether, in the event of their being in a position to supply the electric light at a cost of not more than 6d. per unit, the guardians would consider favourably the proposal to adopt it in the Baker's Row Infirmary. The guardians decided to consider the suggestion.

**Winchester.**—The Hampshire County Council have decided not to light the new county buildings by electricity at present, but only to have the necessary electric wires put in to prevent the walls of the buildings being disturbed at any future date.

**Worcester.**—The Watch Committee have decided to enter into an arrangement with the Brush Electrical Engineering Company to provide a staff for the generating station, to be paid by the corporation, until the contract is completed and the works are finally handed over to the council on January 11th.

**Worthing.**—The first meeting of the newly elected council took a wise step last week when they decided to apply for a provisional order for lighting a certain district. This is the outcome of a report made by Prof. Alex. B. W. Kennedy, recently, in which he advised the following maximum charges per quarter:—For any amount up to 20 units, 15s.; for each unit over 20, 9d. He estimates the cost of the plant (for 3,000 8-candle lamps) at about £27,500; this includes the road-work, plant, lamps, and meters. The sum of £3,500 is included for buildings. Should the scheme he recommends be carried out, an additional expenditure of £7,500 would increase the maximum output by more than 150 per cent. For the sake of the reduction of capital costs, the Professor thinks that the Worthing system ought to be a high-tension one, with current supplied at a pressure of 2,000 volts transformed down to a pressure of 1,000 volts, as usual, before use in premises of consumers. He thinks that the currents for the arcs ought to be passed through rectifiers in the station, as is being done in Portsmouth, and as he is also arranging in Edinburgh.

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**An Electrical Engineer's Failure.**—At a sitting of the London Bankruptcy Court, held last week before Mr. Registrar Hope, Wm. David Gooch, electrical engineer, formerly of Victoria Mansions, Westminster, was allowed to pass his public examination upon accounts showing liabilities, £4,365 19s. 8d., and assets of uncertain value. In the course of his evidence, the bankrupt stated that from 1885 to 1888 he carried on the business of an electrical engineer at 2, Victoria Mansions, Westminster, and then incurred the majority of his present indebtedness in connection with speculative electrical contracts, &c. Since 1888, he had had occasional engagements as consulting and electrical engineer, and for the past five months he had been in the employ of an electric welding company. He attributed his failure chiefly to losses in relation to the speculative electric contracts taken between 1885 and 1888. The examination was ordered to be concluded.

**Auction Sale.**—On Tuesday, Wednesday, Thursday, and Friday next (November 20th—23rd), Messrs. Wheatley Kirk, Price and Goulty will offer for sale by auction a large stock of machine tools, engineer's plant, loose tools, stock, and stores of Messrs. Shepherd Hill & Co., Union Foundry, Hunslet Road, Leeds.

The same firm will sell by auction on the 28th, at Stowage Wharf, Deptford, engines, electrical and other machinery. Details will be obtained from our advertisement columns.

**Awards.**—At the International Exhibitions of Lyons and Antwerp, held this year, the Maschinenfabrik Oerlikon have obtained the highest award (the "Grand Prix") for electrical work.

**Change of Address.**—Mr. F. Stewart, electrical engineer of Blackpool, states that his address is now No. 9, Cow Gap Lane, South Shore, Blackpool, instead of 16, Upper Talbot Street, as formerly. Mr. Stewart has several contracts in hand for electric lighting, one of these being for complete plant for Messrs. Green and Sons, Victoria Street, Blackburn.

**Dissolution of Partnership.**—Notice is given in the *London Gazette* that the partnership heretofore subsisting between Joseph Wilson Swan, Cameron Swan, and William Hardcastle Ward, carrying on business as art engravers by photo electric methods, at 116, Charing Cross Road, under the style or firm of Swan Electric Engraving Company, has been dissolved by mutual consent, as and from the 31st day of October, 1894. All debts due and owing by the said late firm will be received and paid by the said Joseph Wilson Swan and Cameron Swan.

Notice is also published in the *London Gazette* to the effect that the partnership heretofore subsisting between W. E. Townsend, H. D. McIntyre, and W. R. C. Ralston, carrying on business as electrical engineers and contractors, at London and Manchester, under the style or firm of Townsend and McIntyre, has been dissolved, by mutual consent, as and from the 8th day of September, 1894.

**Electrical Trades' Union.**—We are informed that owing to the office of general secretary being vacant, all communications are to be addressed to Mr. R. Steadman, general secretary, *pro tem*, for the present.

**Fire.**—A fire occurred at the works of Messrs. Willans and Robinson at Thames Ditton last week, a shed which contained, amongst other things, several valuable wooden patterns, being completely destroyed.

**J. P. Hall & Co.**—We understand that this firm is now particularly busy in all its departments. Amongst other important contracts they have in hand are the following:—Messrs. Chatterley-Whitfield Collieries, Limited, large installation of arc and incandescent lighting, with engine and dynamo; installation for a large steamer for Messrs. Harland & Wolff, comprising two sets of combined engines and dynamos; dynamos for arc and incandescent lighting for Messrs. Luke & Spencer, Limited, Manchester; complete installation of large private House in North Wales, the dynamo being driven direct by turbine. They have also just completed, amongst others, the lighting of the Freemason's Hall, Oldham, and an extension of about 100 lights for Messrs. Platt Brothers & Co., Limited, of the same town.

**Mill Lighting.**—Staverton Bridge Roller Mills and Stores are lighted by electricity, a dinner in celebration of the inauguration being held last week.

**The Gale.**—Telegraphic communication with the Continent has been partially interrupted during the last few days in consequence of storms.

**New Business.**—A new electrical engineering business has been started at 22, Charing Cross, S.W., under the title of Messrs. Russell & Lennard. Mr. John A. Russell, A.I.E.E., was formerly engineer to Messrs. J. G. Statter & Co., Limited, and Mr. R. F. B. Lennard, A.I.E.E., was recently with Messrs. Latimer Clark, Muirhead & Co., Limited.

**New Premises.**—Mr. Robt. W. Paul, of 44, Hatton Garden, E.C., informs us that he has secured additional factory accommodation at 114 and 115, Great Saffron Hill, E.C., a few doors from Farringdon Street Station. The premises have been fitted with new machinery and engine, and Mr. Paul has accordingly increased his staff. The Hatton Garden premises are retained for office purposes.

**Patent Stamp Book.**—Mr. Ancell A. Coxe, of Salford, is the patentee and manufacturer of "the safety" stamp and postage book. The idea of the invention is to enable a true record of stamps used to be kept with the least possible trouble, and prevent any opportunity for dishonesty occurring in keeping the record. The invention is a very simple one; the chief feature seems to be the division of the pages into so many squares for stamps of various values, and whenever a stamp is taken out, the purpose for which it is used has to be marked in the square make blank by its removal.

**Perry Supply Meters.**—Messrs. Johnson & Phillips have sent us one of their latest price lists (August 1894) of Perry supply meters. We understand that considerable improvements have been made in the design of these instruments during the last few months; notably by substituting permanent magnets for the original shunt coils, thus obviating all loss of power in the instruments. The great accuracy and low starting current, characteristic of this type of meter, have, if anything, been further improved by the above alterations. The meter is enclosed in a watertight and substantial metal case, allowing every facility for installing on consumers' premises, and is designed to meet all the latest Board of Trade requirements.

**Presentation.**—In consequence of the approaching transfer of the dynamo factory of Messrs. Easton, Anderson & Goolden, Limited, in the Harrow Road, to their Erith works, Mr. Slater Lewis, the manager of the former establishment, has retired from the firm, and was, on Monday evening last, the recipient of a handsome present subscribed by the employés, as a token of respect and esteem. Mr. Lewis's services have been retained by Messrs. P. R. Jackson & Co., Limited, of the Salford Steel Works, Manchester, and he will shortly be leaving London for the purpose of taking up his new duties. We understand that he received another offer from a large and well-known firm of engineers. We wish him every success in his new undertaking.

**Price List.**—Messrs. F. H. Joel & Co. have sent us a copy of a new and revised edition of their illustrated catalogue and price list, which, in addition to prices and particulars of plant and materials requisite for electric light and power installations, contains information regarding the fixing and running of dynamos, motors, arc lamps, accumulators, &c. The book is well illustrated and on the whole is well got up.

**South African Telegraphs.**—The telegraph line between Mazoe and Salisbury has been opened.

**The Woking Electric Supply Company, Limited.**—In the Chancery Division of the High Court of Justice on Saturday, 10th inst., Mr. Justice Stirling made the usual order in the debenture holders' action, Chadwick *v.* The Woking Electric Supply Company, Limited. In presenting the prepared minutes to the Court, Counsel explained that there had been the usual accounts taken, and the certificate made showed that there were two issues of debentures. One issue had priority, and the whole of these belonged to the plaintiff, and £3,255 was still owing upon them. There was a second series of debentures, £3,000 of which belonged to the plaintiff and £102 to another gentleman; and the plaintiff had paid off that gentleman and taken a transfer of his interest. Under an order of the Court the Company's business was sold for £3,800, and that sum had been paid into Court. The Receiver had been collecting the outstanding debts, and the whole assets would not be anything like sufficient to discharge the debentures. The assets amounted to about £4,000, and there was due, according to the certificate, on the debentures nearly £6,500.

**Vienna-Berlin Telephones.**—Within a few days telephonic communication will be opened between Vienna and Berlin.

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Derby.**—The Directors of the Midland Railway Company are prepared to receive tenders for the supply of stores for the year 1895. Among the lists of items are the following:—6. Copper and brass tubes, &c.; 6A. Engine fittings—brass; 10. Telegraph instruments, stay rods, bolts, &c.; 10A. Telegraph and signal wires; 12. Lamps, fittings, and tin wares; 13. Gas tubes and fittings—iron; 14. Gas fittings—brass; 34. India-rubber brake pipes, washers, &c. Further details can be obtained from Mr. James Williams, secretary to the company, at Derby.

**Hampstead.**—The Vestry of St. John invite tenders for wiring the buildings in the Stone Yard, Lithos Road, Finchley Road, N.W., for the electric light, including the supply and fixing of all cables and fittings, excepting lamps. Further details will be found among our advertisements.

**Paris.**—The General Direction of the French Posts and Telegraphs, Rue de Grenelle 103, Paris, is inviting tenders until the 22nd inst. for the supply of 71,450 wooden telegraph posts.

### CLOSED.

**London.**—Messrs. Rashleigh Phipps & Co. have secured the contract for wiring 40, Hyde Park Square, W., for the electric light at a cost of £72.

The following tenders were sent in for wiring 49, Lancaster Gate, Hyde Park, and that of Messrs. Rashleigh Phipps & Co. accepted:—

| | |
|---|---|
| Crompton & Co. ... ... ... ... ... | £119 |
| Rashleigh Phipps & Co. ... ... ... | 109 |
| Belshaw ... ... ... ... ... ... | 85 |

The following tenders were also sent in for wiring No. 29, Lancaster Gate:—

| | |
|---|---|
| W. Whiteley ... ... ... ... | £199 17 6 |
| Rashleigh Phipps & Co. ... ... ... | 105 0 0 |

The following is a list of the tenders sent in for wiring the "Leicester." The lowest tender, which was the one accepted, will be seen to be less than a third of the amount of the highest:—

| | | |
|---|---|---|
| Messrs. | Samuel Cutler & Sons ... ... ... | £323 0 |
| „ | E. L. Berry Harrison & Co. ... ... | 180 0 |
| „ | B. Verity & Sons ... ... ... ... | 167 8 |
| „ | New & Mayne ... ... ... .. | 134 0 |
| „ | Vaughan & Brown ... ... ... | 130 0 |
| „ | Watson & Co. (accepted) ... ... | 104 10 |

## NOTES.

**Our Illustrations of Bolton.**—We omitted to say that the illustrations of Bolton Electric Light Works, given in our last issue, were from photographs by Mr. T. H. Heyes, 150, Deansgate, Bolton.

**Institution of Junior Engineers.**—Mr. Alexander Siemens has accepted the Presidency of the Institution of Junior Engineers for session 1894-95, in succession to Mr. J. Wolfe Barry, C.B., &c., and will deliver his presidential address this evening (16th inst.) at the Westminster Palace Hotel.

**Fuel Economiser Tests.**—We learn that some trials are shortly to be made at the City of London Electric Lighting Company's Station, at Bankside, on Messrs. Green's ordinary economiser and Calvert's circulation economiser, the company, as purchasers, having retained the services of Prof. Alex. B. W. Kennedy, F.R.S., to make these tests.

**The Northern Society of Electrical Engineers.**—At the ballot for new members last Monday night, the following were elected:—J. D. Bailie, Leeds; A. H. Gibbings, Hull; W. J. Hide, Liverpool; C. F. McInnes, Leicester; W. D. Reid, Nottingham; Joseph Tinker, Newton.

**Lectures.**—The seventy-fourth session of the Royal Scottish Society of Arts was opened last Monday night in the Albert Hall by Mr. S. Z. de Ferranti, who delivered a lecture on "Electrical Developments of the Future and their Effect upon Everyday Life."

**Royal Institution.**—The Christmas course of lectures, adapted to children, at the Royal Institution will be delivered by Prof. J. A. Fleming, F.R.S., Professor of Electrical Engineering in University College, London. The subject will be "The Work of an Electric Current," and the first lecture will be delivered on Thursday, December 27th, at 3 o'clock.

**The Institution of Electrical Engineers.**—On Thursday, November 22nd, 1894, a paper will be read on "Electrical Steep Grade Traction in Europe," by Charles S. du Riche Preller, M.A., Ph.D., member. The following papers will be discussed:—"Notes on Electric Tramways in the United States and Canada," by H. D. Wilkinson, member; "Electric Traction, with Special Reference to the Installation of Elevated Conductors," by R. W. Blackwell, foreign member, and Philip Dawson, associate.

On Friday, November 16th, is to be held the Students' annual meeting, at 28, Victoria Street, S.W., for the election of committee and secretary.

**The Accident in the City.**—The facts of the accident in the City, culled from the newsparers, seem to be as follows:—A man named George Clark was driving a single horse brougham belonging to Mr. Wrigley, contractor, along Cannon Street, on Saturday afternoon, and was just turning into Walbrook, when the horse suddenly fell down, shaking violently. The coachman, thinking the horse was ill, jumped down with the intention of unharnessing it, and was immediately followed by another person who had been riding with him on the box. A warehouseman also rushed to their assistance, but they were unable to do anything, as they experienced a severe electric shock, to avoid which they had to seek the safety of the pavement. In three or four minutes the animal was dead. A crowd soon gathered about the spot, and several people on venturing too near were subjected to a severe shock, which caused them to fall to the ground. Three persons received injuries which rendered their removal to a hospital advisable, and they were taken to St. Bartholomew's. Within a few minutes of the horse's death three explosions took place, and one of the box covers of the electric light mains was forced out of its socket. The police were soon on the spot, and kept the crowd back, while labourers fenced off the pavement and the box covers. Engineers quickly arrived and began to explore for the leak. The only other accident of the kind that has taken place in this country was at Bournemouth about a year ago, and a horse was then also the victim. The three persons who were taken to St. Bartholomew's Hospital gave their names as Edwin Loveland and Albert Moody, both of 131, Rhodeswell Road, Limehouse, and Thomas Cowley, of Cloudesley Road, Islington. They were at once treated by the house surgeons, and later on in the day were able to leave the hospital. It is stated by the engineers of the City of London Electric Lighting Company that the explosion is probably to be accounted for by an escape of gas coming into contact with an electric current. A thorough investigation, however, is to be made into the affair, and a *post mortem* examination will be made of the body of the horse. As far as we can ascertain the cases of shock which went to St. Bartholomew's presented no definite symptoms. We do not wish to harass the enquiry which is to be held on Monday by making any comments at the present stage. With regard to the accident the British Insulated Wire Company ask us to state that cables of their make were in no way responsible for the trouble.

**Electrical Communication with Irish Lighthouses.**—The Commissioners of Irish Lights intend connecting eleven lighthouses electricallly with the Postal Telegraph system.

**The Pacific Cable.**—A cable message, which has just been received at Ottawa, states that Lord Ripon has in contemplation the calling of another inter-colonial conference. Mr. Mackenzie Bowell, in the course of a speech at Ottawa, said that he saw no necessity for the immediate gathering of another conference, when the Governments interested were already in possession of all the necessary facts respecting the proposed Pacific cable. A conference might be necessary to make final arrangements. The delegates of the Imperial and Colonial Governments would then require to be in a position to pledge their respective Governments on the question of liability. Mr. Mercier has left for England. Before his departure he had a long interview with Mr. Mackenzie Bowell on Hawaiian and cable questions, and expressed much satisfaction at the fact that the cable can reach land without touching the Hawaiian group.

The *Times* correspondent at Ottawa telegraphs under date November 8th:—"The report of her Majesty's ship *Champion*, which recently surveyed Neckar Island, shows that the island is not well adapted for a cable station. Bird Island, 250 miles from Honolulu, which was visited by Mr. Fleming on his recent trip, possesses greater advantages. Mr. Fleming and Mr. Mercer arrived here to-day."

**Executions by Electricity.** — The question of the possible survival of criminals who have been executed by means of electricity has been frequently discussed in America, and as opinions are greatly divided on the subject, the Hon. Roswell P. Flower, Governor of the State of New York, announces that he will permit an experiment to be made to settle this point. A man named Wilson is now under sentence of death, and will be electrocuted next month. The doctors who attend the execution in order to certify to the cause of death, and make the post-mortem examination are, in accordance with the Governor's decision, to be allowed to attempt to resuscitate him, and if they succeed Wilson will be pardoned. In the first executions by means of electricity, as prescribed under the change of law in New York State about four years ago, the public was greatly shocked by published statements that the criminals breathed and even groaned after the first shock had been passed through their frames. Later, with improvements in the apparatus, these phenomena were not observed, but in order to insure that life should be absolutely extinct, the current has been applied for a certain number of seconds, then shut off, and turned on again, although the first application was really considered sufficient.—*Dalziel.*—[We feel sure that, however greatly the public may have been shocked at the first efforts at electrocution, this kind of thing will meet with general and real protestations of indignation. It is perfectly well known at the present day that death is made swift and sure by the application of the electric shock, and this suggested experiment seems to us not only perfectly unwarranted, but utterly repugnant to civilised notions. It looks almost as if the Hon. Roswell P. Flower has been made the catspaw of certain medical men, who probably have only their own ends to serve, public feeling being dragged in so as to lend weight to the barbarous notion. To try to resuscitate a man who has accidentally become the subject of an electrical shock commends itself to everybody; but in this instance we are confronted with what may be a very questionable experiment. If the shock is properly applied for a definite time, there can be no doubt that the criminal will be killed; but who is to say whether the shock will not be deliberately applied in such a manner, and during such an infinitesimal period of time, that the probable chances are life has not actually fled from the body of the poor wretch. What then would his recovery prove but that he wasn't dead? We have overwhelming proof, from the practical demonstrations already carried out in American prisons, that electrocution is a speedy and certain end, if, therefore, it is intended that it should be so, the resuscitation of the tortured criminal would merely show that it had not been properly carried out.—Eds. Elec. Rev.]

**Joint Stock Companies.**—The Board of Trade have appointed a committee to inquire what amendments are necessary in the Acts relating to joint stock companies incorporated with limited liability, especially with a view to the better prevention of fraud in relation to the formation and management of companies, and to consider and report upon the clauses of a draft Bill which will be laid before them for that purpose. The following will form the committee, viz.:—Lord Davey, the Hon. Mr. Justice Chitty, the Hon. Mr. Justice Vaughan Williams, Sir William Houldsworth, M.P., the President of the Associated Chambers of Commerce (Sir Albert Rollit, M.P.), Mr. A. F. Wallace (a director of the Bank of England), Mr. H. B. Buckley, Q.C., Mr. F. B. Palmer, Mr. John Smith (Inspector General in Bankruptcy), Mr. John Hollams, Mr. F. Crisp, Mr. E. Waterhouse, and Mr. George Auldjo Jamieson. Mr. T. Girdwood Macfie has been appointed secretary. With such an eminent and searching committee appointed to investigate a matter of the utmost intricacy, we may hope to have some important improvements suggested in the various details connected with limited liability companies and their management. That vast amendments are really necessary is not disputed by anyone who has had any experience regarding joint stock companies.

**Some Potential Determinations.**—The researches of B. Neumann on voltaic electricity have been very frequently the subject of notice in these pages. He seems determined to prosecute his investigations to the most complete issue, and every new paper that he publishes enriches our knowledge of this subject with new data. His latest researches have been devoted to the estimation of the potential of hydrogen and some of the metals, and are described in the *Zeitschrift für Physikalische Chemie*, xiv., pp. 193—230. Voltaic elements were formed, consisting of the chain, mercury, potassium chloride, a normal salt solution, and the metal present in the salt. The difference of potential between the metal and its normal salt solution was calculated from the observations of the electromotive force. For hydrogen salts the electrode consisted of a platinum rod covered with a layer of platinum black, half immersed in the acid and half in the hydrogen. A capillary electrometer was used, and the observations lead to the following results for the difference of potential between the metal and the solution :—

| | Sulphate. | Chloride. | Nitrate. | Acetate. |
|---|---|---|---|---|
| Magnesium ... | + 1·239 | + 1·231 | + 1 060 | + 1·240 |
| Aluminium ... | 1·040 | 1·015 | 0 775 | — |
| Manganese ... | 0·815 | 0·824 | 0 560 | — |
| Zinc ... ... | 0·524 | 0·503 | 0·473 | 0·522 |
| Cadmium ... | 0·162 | 0·174 | 0·122 | — |
| Thallium ... | 0·114 | 0·151 | 0·112 | — |
| Iron (ferrous) ... | 0·093 | 0 087 | — | — |
| Cobalt ... ... | − 0·019 | − 0 015 | − 0 078 | − 0·004 |
| Nickel ... ... | 0·022 | 0 020 | 0 060 | — |
| Tin ... ... | — | 0 085 | — | — |
| Lead ... ... | — | 0 095 | — | — |
| Hydrogen ... | 0·238 | 0·249 | — | 0·150 |
| Bismuth ... | 0·490 | 0·315 | 0·500 | — |
| Antimony ... | — | 0·376 | — | — |
| Arsenic ... | — | 0·550 | — | — |
| Copper... ... | 0·515 | — | 0 615 | 0·580 |
| Mercury ... | 0·980 | — | 1·028 | — |
| Silver ... ... | 0·974 | — | 1·055 | 0 991 |
| Palladium ... | — | 1·066 | — | — |
| Platinum ... | — | 1·140 | — | — |
| Gold ... ... | — | 1·356 | — | — |

It was found, as had been previously suspected, that the last nine metals in the foregoing list are precipitated from their solutions by hydrogen. Experiments with thallium salts indicated that, with equal concentration of the metallic ions, the negative ion has no influence upon the difference of potential. The values of the electromotive force of chains containing various oxidisers and reducers were also observed in this investigation, and hence the electromotive force between the platinum and the oxidiser (*vel* reducer). It is worthy of remark that of the 40 different compounds placed under examination by Neumann, only four gave a positive difference of potential, namely, stannous chloride, sodium sulphide, hydroxylamine, and chromous acetate.

**The Conductivity of Solutions.**—When a portion of the water in an aqueous solution of an electrolyte is replaced by a non-electrolyte, so that the total volume remains unchanged, the electrical conductivity of the solution diminishes. S. Arrhenius showed (*vide Zeitschrift für Physikalische Chemie*, V. ix., p. 487) that if the quantity of non-electrolyte added ($x$) does not reach more than 10 per cent., the conductivity of the solution may be expressed by the formula,

$$l = l_o \left(1 - \frac{a}{2} x\right)^2$$

where $l_o$ is the conductivity of the pure aqueous solution, and $a$ an empirical coefficient. R. J. Holland has also investigated the alteration of the conductivity of a solution by the addition of a small quantity of a non-electrolyte (*vide Berichte der Deutschen Chemischen Gesellschaft*, xxv., p. 2,726), and has arrived at the same expression, but the constant $a$ differs greatly from that obtained by Arrhenius. As we have noticed, both of these researches in the Electrical Review, 1892, second volume, it is interesting to observe that the subject has been more fully investigated by N. Strindberg, in the light of the knowledge since acquired. His results, which are given in the *Zeitschrift für Physikalische Chemie*, V. xiv., pp. 161-162) agree well with those of Arrhenius, but differ from those of Holland to the extent of from 24 to 56 per cent.

## The New Electric Station.

"Just the place for a station," th' electrician exclaimed
As he placed a new dot on his map.
"Just the place for a station," his assistant proclaimed
As he wiped his hot brow on his cap.
"Just the place for a station, we both do believe,"
Said the boss and the boy by his side,
"Just the place for a station, and we cannot conceive
How what's thrice said can e'er be denied."
So they drew up their plans, which included a pump
And a water wheel, too, of some kind;
For ev'ry one knows, lest he be a great chump,
That water beats steam out of mind.
Then they built them two tanks the water to hold,
And the lower one filled from the lake
Some ten miles away—the project was bold—
They were sure, though, they'd made no mistake.
For 'twas easy to see that with bucket and pail
All the water required could be had
In a trip or two more, or, perchance, should this fail,
In a trip or two less, by the lad.
We've said once before that the project was bold,
And we say it again to be sure;
We say it three times, for what thrice has been told
Will most certainly always endure.
The plan it was this, which I'm 'lowed to reveal—
To pump water from low tank to high
And then let it flow to the said water wheel
And be pumped up again, by-and-bye;
Thus by using the water o'er and over again
The trips to the lake might be stopped,
For the water when pumped would act just the same
As it did when the first time it dropped.
By connecting the pump to the said water-wheel
Circulation would ever proceed,
And the dynamo keyed to the wheel's shaft of steel
Would give all the current they'd need.
The project was bold, as we've said once before,
And we say it again, just for fun;
And then we would fain repeat it once more,
For a scheme thrice proposed is half done.
So they wired up the station with high insulation,
With meters for ampères and volts,
And with all other fixings of ingenious creation
As detectors of all kinds of faults;
Nor Niagara nor Culmbanks could ever compete
With a station so carefully planned,
With every detail followed out so complete,
Based on ideas so novel and grand.
It could charge up a bill or electrical belt,
'Lectric combs, tooth and hair brushes, too,
And give current enough to be easily felt,
Which is all that Niagara could do.
That the project was bold you need not be told,
But I think it is best to repeat
E'en a third time, although the story be old,
For what's three times well said is complete.
The plant being now in its most complete form,
Not a bolt nor a wire out of place,
They decided one day 'mid a crowd to perform
The wonders they'd planned with such grace.
So with feelings of pride and pleasure, I wot,
And with other kinds also, I ween,
They turned on the pump, but found they'd forgot
The dynamo-electric machine.

By Electricus in the *Western Electrician*.

**The Western and Brazilian Telegraph Company, Limited.**—The Western and Brazilian Telegraph Company, Limited, last Thursday afternoon (November 8th) received from their representative in Rio de Janeiro the following communication:—"Urgent—Bill presented yesterday in Congress, and published to-day, November 8th, in *Diario Official*, authorising the Government to purchase at once the Western and Brazilian Telegraph Company under conditions of Clause 14, Decree 5,270, of April 26th, 1873, of the Western Company's concession, and to emit special telegraph bonds value £100 sterling, bearing interest at 5 per cent. per annum for this purpose."

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**Foreign Originality.**—*Helios*, a Leipzig paper, in a recent issue says:—"The experiments made by the *Allgemeine Electricitäts-Gesellschaft*, on the Wannsee, near Berlin, as to the telegraphy without metallic conductors, were visited lately by the Secretary of State of the Imperial Ministry of Marine. The experiments were executed by the engineer, Erich Rathenau, after a system made by himself, and rendered the telegraphic service possible between the electric central stations of Wannsee and Neu Cladow, on the Havel, *i.e.*, a distance of 4·5 kilom. The Secretary of State pronounced his entire satisfaction with the surprising result." This is not the first time that our German friends have taken credit for the ideas of other people, and made use of them in a form which gives an air of originality to them. Not long ago a little scrimmage took place in the pages of *Elektrotechnische Zeitschrift* with reference to methods of fast-speed working, in which the source of inspiration of the idea was conveniently ignored.

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**An Application of Electricity to the Bleaching of Paper Pulp.**—The operation of bleaching is evidently of prime importance in the manufacture of the finer qualities of paper. At present it has to be conducted with great care and at considerable expense; hence it has been proposed to produce the bleaching agent in the vat containing the pulp by means of electrolysis. We believe that several processes for effecting this have been devised, but the latest of which we have any information is due to the ingenuity of J. W. Abom, of Stockholm. Under his system the pulp is placed in a receptacle of wood or stone, or of any non-conducting material which is not acted upon by chlorine. A solution of a chloride of the alkalies or alkaline earths is now poured into the vat containing the pulp, and an electric current is made to traverse it. The electrodes are carbon plates, and they are arranged that one is near the circumference of the vessel whilst the other is at the centre. When the current has been in action for 20 to 40 minutes the contents of the receptacle are discharged into another vessel, where the bleaching proceeds of itself, and is allowed to go on until the proper degree of whiteness is attained by the pulp. During the bleaching operation in the electrolytic vat the chlorides are, of course, converted into hypochlorites by the action of the current. Care has to be exercised, however, that the temperature does not rise too high, or the hypochlorite will be converted into chlorate—a substance which possesses no bleaching properties.

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**Is a Maximum E.M.F. Necessary before Electrolysis?**—In a recent issue of the *Zeitschrift für Physikalische Chemie*, there is an important paper over the signature of D. Wiedeburg, which contains a consideration of the vexed question whether a certain maximum electromotive force is required before electrolysis is effected. The author is of opinion that with any given electromotive force (A) there corresponds a certain pressure ($p$) of the gaseous product, according to the equation:—

$$A_1 - A_2 = c \log \frac{p_1}{p_2},$$

and hence, that electrolysis is set up by any electromotive force, however small it may be. He supports this view by means of experimental results, as well as by mathematical analysis; and further, finds that the ratio of current to E.M.F. is given by a curve consisting of two straight lines connected by a short curve, and of such a total configuration that it is, approximately speaking, a hyperbola. When the curve is very short, an apparent break occurs, the position corresponding with the maximum of polarisation. As these results practically negative the question of maximum electromotive force in electrolysis, it will doubtless be much canvassed, especially by MM. Berthelot, Nourisson, and Le Blanc, whose work on the subject we have recently referred to in these pages, and the author will probably have to adduce further evidence in support of his conclusions before they will be generally accepted. Meanwhile, as some of our readers may desire to study the paper in full, we refer them to the *Zeitschrift*, xiv., pp. 174—180.

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## NEW COMPANIES REGISTERED.

**Liddell Engineering Company, Limited** (42,366).—This company was registered on the 5th inst. with a capital of £5,000 in £1 shares, to acquire and take over as a going concern the undertaking of the Liddell Engineering Company, and all its property, assets and liabilities; to enter into an agreement for this purpose; and to carry on the business of general and electrical engineers, metallurgists, boiler manufacturers, and all similar trades. The subscribers (with one share each) are:—B. H. de Jersey, 5, Broadway, Bromley, Kent, solicitor; N. S. de Jersey, 91, Messina Avenue, West Hampstead, Clerk in Holy Orders; W. B. de Jersey, M.B., 94, Finchley Road, South Hampstead; M. E. Atkins, 14, Thicket Road, Anerley, S.E., spinster; F. M. Liddell, 19, Schubert Road, Putney, married woman; J. E. de Jersey, Grange Lodge, Guernsey, engineer; A. Y. Hyland, Cawrie, Brasted, Kent, solicitor. There are never to be more than five directors; the first are—P. S. Liddell and J. Esten de Jersey. Qualification £100. Remuneration to be decided in general meeting. Registered by Hyland and Atkins, 34, Walbrook, E.C.

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**Michael Corbett & Sons, Limited** (42,379).—This company was registered on the 7th inst. with a capital of £50,000 in 5,000 shares of £10 each, to acquire and carry on the businesses and assets of T. W. Spence & Co., Limited, at Hebburn and elsewhere, and to carry on the businesses of manufacturers of hemp wire ropes, telegraph, telephone, and electric light cable manufacturers, electrical appliance manufacturers, &c. The subscribers (with one share each) are:—R. Dixon, Gunningate Hall, Middlesboro', shipbuilder; H. B. Olsen, W. Hartlepool, ship chandler; G. Shaw, High Hazel Hall, Nr. Sheffield, colliery proprietor; W. Millson, Gateshead, merchant; C. W. Demston, Ryton, shipowner; J. E. Rogerson, Durham, steel manufacturer; J. F. Corbett, Newcastle-on-Tyne, ropemaker. There are not to be more than five directors; qualification, £500; remuneration (exclusive of managing director), £100 per annum divisible; remuneration managing director, £700 per annum and percentage. Registered by Nash Field & Co., 12, Queen Street, E.C.

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**Randall's Phonautograph Co., Limited** (42,412).—This company was registered on the 9th inst. with a capital of £25,000 in £1 shares to adopt a certain agreement expressed to be made between W. J. Hailstone, and W. H. Cook; and to carry on in the United Kingdom, and elsewhere, the business of manufacturers of and dealers in (either wholesale or retail) instruments known as, and called by the name of phonautographs, or phonographs, and other instruments for recording articulate speech and other sounds. The subscribers (with one share each) are:—J. Martin, Mornington Road, Woodford, gentleman; W. H. Cook, Southchurch Brack, Southend, gentleman; E. H. Winter, 30, Arthur Road, Holloway Street, accountant; J. B. Goodman, 8, Barnsbury Park, Islington, N., electrical engineer; A. G. Seaman, Preston House, Surbiton, electrical engineer;

C. T. Libbins, 33, Denver Road, Stamford Hill, provision merchant; G. Hales, 55, Somerset Road, Tottenham, commercial clerk. There are never to be more than five directors: qualification, £50; remuneration, £300. Registered by Taunton & Dade, 21, Copthall Avenue, E.C.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**London and Lancashire Electric and General Engineering Company, Limited.** — This company's last annual return shows that, out of a nominal capital of £20,000, in £5 shares, 1,987 shares have been taken up; and that a sum of £2 per share has been called on 987 of these. The total received is £1,847; £5,000 has been agreed to be considered as paid; and £127 is outstanding.

**Chloride Electrical Storage Syndicate, Limited** (35,389).—This company filed on September 24th, 1894, its yearly return, which shows that, out of a nominal capital of £262,500, in 110,000 "A," 140,000 "B," and 12,500 founders' shares of £1 each, 70,000 "A," 100,000 "B," and 12,500 founders' shares have been taken up, and that the full amount has been called on each share. The sum received is £25,000, and £157,500 has been agreed to be considered as paid.

**Column Printing Telegram Syndicate, Limited** (29,493).—The annual return of this company has been filed, and shows that out of a nominal capital of £25,000 in £50 shares, 249 have been taken up. £5,000 has been agreed to be considered as paid on 100 of these shares, and the full amount has been called on each of the remaining shares. A sum of £6,800 has been received, and £650 is outstanding.

**Dalziel's Cable News Agency, Limited** (30,264).—This Company filed on September 12th last, a notice to the following effect:—"That it has been proved to the satisfaction of this meeting" (held August 29th last) "that the company cannot by reason of its liabilities, continue its business, and that it is advisable to wind up the same, and accordingly that the company be wound up voluntarily, and that Mr. John Macdonald Henderson, F.C.A., be appointed liquidator for the purpose of such winding up, at a remuneration of 100 guineas."

**Electric Clock Company, Limited** (36,517).—Messrs. Steadman, Van Praagh, Sims & Co., in writing the Registrar of Joint Stock Companies, state that the above-named concern has never done any business.

**Electric Lamp Company, Limited** (36,706).—This company's last return shows that out of a nominal capital of £4,000, in £1 shares, 2,797 shares have been taken up, and that the full amount has been called on 107 shares. A sum of £81 2s. 1d. has been received, £2,690 has been agreed to be considered as paid, and £25 17s. 11d. is yet outstanding.

**General Electrolytic Parent Company, Limited** (39,358).—This company's yearly return was filed on the 25th ult., and shows that out of a nominal capital of £24,000 in £1 shares, the whole of the shares have been taken up, and that £1 has been called on each of 6,000 of them. A sum of £5,000 has been received, £18,000 has been agreed to be considered as paid, and £1,000 is outstanding.

**Lamina Accumulator (Elieson's British Patents) Syndicate, Limited** (39,144). — The registered office of this company has been moved from 8, Regent Street, W., to Broad Street Avenue, E.C.

**Miner's Lamp Electric Lighting Company, Limited** (28,019).—The yearly return of this company shows that out of a nominal capital of £3,000 in £5 shares, 301 shares have been taken up, and that the full amount on 190 of these has been agreed to be considered as paid. A sum of £550 has been received on the remaining shares; and there is yet £5 outstanding.

**Mather & Platt, Limited** (36,368).—On the 2nd inst. this company filed its yearly return, which shows that out of a nominal capital of £200,000, in £10 shares, 15,000 shares have been taken up, and that £9 has been called on each of them. The sum received is £135,000—the full amount of calls.

**National Telephone Company, Limited** (15,066).—This company's yearly return shows that out of a nominal capital of £4,000,000, in 15,000 £10 first preference, 15,000 £10 second preference, 250,000 £5 third preference, and 490,000 £5 ordinary shares, the whole of the first and second preference, 119,234 of the third preference, and 484,597 ordinary shares have been taken up. The full amount has been called on the first and second preference, 90,950 of the third preference, and 449,569 of the ordinary shares. The sum received equals £3,002,595, and £316,560 has been agreed to be considered as paid.

**Omnibus and Tramcar Electric Lighting Company, Limited** (39,656).—The statutory return of this company shows that only the seven signatories' shares, out of a nominal capital of £60,000, in £5 shares, have been taken up. A call of £1 per share has been made, and the amount has been fully paid.

**Otis Elevator Company, Limited** (38,450). — This company's last return shows that out of a nominal capital of £50,000 in £10 shares, 2,000 have been taken up, and that the full amount has been called on 1,350 of these. A sum of £13,500 has been received, and £6,500 has been agreed to be considered as paid.

## CITY NOTES.

### The County of London and Brush Provincial Electric Lighting Company, Limited.

The directors' report and accounts up to June 30th, 1894, is as follows:—

*County of London.*—The work necessary for giving effect to the provisional orders held by the company for the districts within the County of London is in active progress under the contracts mentioned in the prospectus of March 28th, 1894, and by which it is provided that generating plant, capable of supplying 90,000 8-C.P. glow lamps, shall be erected by September 30th, 1895.

Contracts for the laying of pipes for street mains have been entered into, and are now being executed. It is intended to at once lay sufficient conductors to meet immediate requirements, together with a number of spare pipes into which, without further disturbance of the roadway, additional cables may be drawn when required.

The directors have acquired at a moderate rental, under a 99 years' lease, a suitable site at the Regent's Canal Basin, upon which the generating station for the St. Luke's and Clerkenwell districts will be erected, and they have made arrangements with the owners for obtaining additional land, should it become necessary at any time to enlarge the buildings.

The freehold has also been secured of riverside premises in the Wandsworth district, upon which the generating station for that area will be built.

At both these stations coal can be delivered out of barges alongside the buildings, and there is an abundant supply of water available for boiler feeding and condensing purposes.

*Provinces.*—The company has purchased a controlling interest in the Bournemouth and District Electric Supply Company, the extension of whose business during the past year has been very encouraging, and it is expected that the accounts for 1894 will show a substantial profit. The connections to the mains of the Bournemouth Company are now equivalent to about 18,000 8-C.P. lamps.

The company is also largely interested in the Dover Electricity Supply Company. Work upon the station buildings and mains of that company is approaching completion, and it is expected that it will be in a position to supply current to consumers by the end of the present year. The prospects of the Dover Company are very hopeful in view of the arrangements already entered into with the corporation for street lighting, and with the military authorities. Other important lighting contracts at Dover are also in course of negotiation, with every probability of a satisfactory conclusion.

At Windermere the water-power of the River Leven, at the outlet of Lake Windermere, has been secured, and the Windermere and District Electricity Supply Company has been formed for the purpose of utilising this power in supplying current at a moderate price to such towns in the neighbourhood as may desire to avail themselves of it.

*Future Annual Accounts and General Meetings.*—It is intended to close the financial year in future on December 31st, and to present the accounts to that date at the annual general meeting to be held in March or April following. Under this arrangement the next general meeting will be held early in 1895, when the provisions contained in the articles of association with regard to the retirement and election of directors and auditors will take effect.

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BALANCE SHEET, June 30th, 1894.

| | £ s. d. | £ s. d. |
|---|---|---|
| To Authorised capital £800,000. | | |
| „ Capital issued ... ... ... | 200,000 0 0 | |
| Less calls not due ... ... | 119,600 0 0 | |
| | 80,400 0 0 | |
| Plus calls paid in advance ... | 1,604 0 0 | |
| | 82,004 0 0 | |
| Less calls falling due June 30th | 33,602 0 0 | |
| | | 48,402 0 0 |
| „ Sundry creditors ... ... ... ... ... | | 2,739 14 10 |
| | | £51,141 14 10 |

Note.—The contingent liability upon the shares in associated electricity supply companies is £6,000.

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| | £ s. d. |
|---|---|
| By Preliminary and other capital expenses—(viz.: formation of company, increase of capital, purchase of orders, and outlay in respect of applications for same ... ... ... ... | 17,942 18 0 |
| „ Lands and building account: Payment for release of premises ... ... ... ... ... | 100 0 0 |
| „ Shares in associated electricity supply companies, at cost ... ... ... ... ... ... | 21,850 0 0 |
| „ Advances to associated electricity supply companies against bills of exchange and collateral security, £8,645 2s. 9d.; less rebate for interest not accrued, £233 18s. 11d. ... ... ... | 8,411 3 10 |
| „ Preliminary expenditure on account of proposed undertakings ... ... ... ... ... | 812 0 2 |
| „ Office furniture, books, &c. ... ... ... ... | 172 5 7 |
| „ Sundry debtors ... ... ... ... ... | 533 11 2 |
| „ Directors' remuneration, salaries, rent and current expenses from June, 1891, to June, 1894 ... | 1,164 14 7 |
| „ Cash at bank and in hand ... ... ... ... | 155 1 6 |
| | £51,141 14 10 |

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## The Western and Brazilian Telegraph Company, Limited.

THE directors, in their report, state that the total earnings for the half-year ended June 30th, 1894, amount to £77,603 3s. 6d., as against £79,373 10s. 4d., a decrease of £1,770 6s. 10d., compared with the half-year to June 30th, 1893. The working expenses amount to £39,739 11s. 5d., as against £43,424 1s. 3d., a decrease of £3,684 9s. 10d. Including the amount brought forward from 1893 (£1,045 6s. 6d.), the balance to the credit of the revenue account is £38,908 18s. 7d., from which has to be deducted £11,672 10s. for debenture interest, £5,000 for the debenture redemption fund, and £2,000 placed to reserve fund. This leaves £20,236 8s. 7d. Looking at the improvement apparent in Brazilian affairs, the directors are of opinion that they can prudently recommend the payment of a dividend, free of income tax, for the half-year, at the rate of £2 per cent. per annum, carrying forward £5,630 6s. 7d. This dividend will be payable as follows, viz.—3s. per share to the ordinary shares, and 3s. per share to the preferred ordinary shares. The volume of traffic for the period referred to in these accounts shows a large increase in the number of words carried, as compared with the corresponding period of 1893, but, owing to the causes before explained, and the low rate of exchange, the income is less; the directors are, however, pleased to state that the rate of exchange has improved since August. The traffic over the Pacific and European Company's line connecting Buenos Ayres with Valparaiso, which was opened in March last, has steadily developed, and shows encouraging prospects. The companies interested determined to allow a period of six months to elapse to see how this traffic progressed before settling the proportions of the through rates to be allotted to each company; consequently no credit has been taken for this business, which will be included in the next account, and promises to produce a satisfactory and permanent addition to the company's income. Now that the Courts have re-opened, it is expected that the question in litigation between this company and the Brazilian Submarine Company on the subject referred to in the last report, will soon be heard. The directors, as before advised, have taken credit for the sum in dispute, but have carried over a larger balance to meet contingencies. The directors have to notify that the conversion of ordinary shares into preferred ordinary and deferred ordinary shares will be suspended on and after January 1st, 1895, until further notice. The dividend warrants will be posted on the 16th inst.

## West India and Panama Telegraph Company, Limited.

THE thirty-fifth ordinary general meeting of this company was held on Wednesday at Winchester House, Mr. C. W. Earle presiding.

In moving the adoption of the report and accounts, the CHAIRMAN said again they had the discouraging recurrence of the paragraph which had appeared in five of the last seven reports, that the traffic receipts showed a decrease. The total of these decreases, balanced against the two periods in which there were small increases, showed a loss to the company of about £18,000. The decrease of this half-year, after eliminating the result of the piece of luck they had last year in the breakage of the French cable, was about £2,000 on the normal traffic of the company. They still suffered through the codifying systems, and the chief cause of their bad times was the condition of affairs in the Islands. As a special instance, he mentioned Dominica, where in the early days of the company sugar was sold at 27s. per cwt., while at the date of the last meeting it was at 10s. 9d. to 11s. 9d. per cwt., as against 12s. to 13s. at the previous meeting date. Now it is only fetching from 8s. 9d. to 10s. It would thus be seen that the value was continually decreasing; an economical change had taken place in the West Indies. Regarding the accounts, there was a decrease in expenditure of about £300, but this was more apparent than real. Cable repairs and renewals showed an increase, for there was an important break in one of their cables, by which they lost some valuable grappling gear, and, altogether, the repair cost about £4,000. That sum represented two years of their Jamaica subsidy, yet they were sometimes told that their subsidies were excessive. He moved the adoption of the report and the declaration of dividends as recommended therein.

Mr. W. S. ANDREWS seconded the motion, which was carried, and the meeting closed with the usual vote of thanks.

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## Westminster Electric Supply Corporation.

LORD SHEFFIELD presided on Wednesday at an extraordinary meeting of this company for the purpose of confirming the resolution passed a fortnight ago authorising the increase of capital from £300,000 to £400,000. It was expected that the terms of the issue would be announced, but the chairman said they had not quite decided on the form of issue, but the shareholders would be informed as soon as their minds were made up. The resolution was then adopted.

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**Swan United Electric Light Company, Limited.**—The liquidator announces that notices have been posted to the shareholders requesting them to send in their Swan United certificates in exchange for the new securities. Each holder of five fully-paid shares will receive in exchange as follows:—$3\frac{1}{4}$th fully-paid (£5) shares in the Edison & Swan United Electric Light Company, Limited; £6 0s. 7d. debenture stock; £1 0s. 8d. cash, being dividend and interest to June 30th, free of income-tax. Each holder of five partly-paid shares will receive as follows:—$3\frac{1}{5}$th partly-paid (£3) shares in the Edison & Swan Company; £4 16s. 6d. debenture stock; 14s. 2d. cash, dividend and interest.

**The Home Telephone Company, Limited.**—The creditors of the above company are required, on or before December 14th, to send in their names and addresses, and the particulars of their debts or claims, to Mr. E. A. Horne, of 85, Queen Victoria Street, London, E.C., the liquidator of the said company; and, if so required, by notice in writing from the said liquidator, are to prove their debts or claims at such time and place as shall be specified in such notice, or in default thereof they will be excluded from the benefit of any distribution made before such debts are proved.

**The Wiliamson Electrical and Engineering Company, Limited.**—A general meeting of the above company will be held at Temple Chambers, 33, Brazennose Street, Manchester, on December 17th, at 12 o'clock noon, for the purpose of having an account laid before them, showing the manner in which the winding-up has been conducted, and the property of the company disposed of, and of hearing any explanation that may be given by the liquidator.

**The Herculite and Electrical Manufacturing Company, Limited.**—At an extraordinary general meeting of the above company, held at 28B, Bower Road, Hackney Wick, on October 17th, 1894, a resolution was passed deciding to wind up voluntarily, as the company cannot, by reason of its liabilities, continue its business. At the same meeting W. H. Shephard was appointed liquidator for the purposes of such winding-up.

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## TRAFFIC RECEIPTS.

**The City and South London Railway Company.** The receipts for the week ending November 11th, 1894, amounted to £969; week ending November 12th, 1893, £911; increase, £58; total receipts for half-year, 1894, £16,719 corresponding period, 1893, £15,591; increase, £1,128.

The Liverpool Overhead Railway Company. The traffic receipts for the week ending November 11th, 1894, amounted to £892; corresponding week last year, £577.

**The Western and Brazilian Telegraph** Company, Limited. **The receipts for the week ending** November 9th, after deducting **17 per cent. of the gross receipts payable to the London** Platino **Brazilian Telegraph** Company, **Limited, were £**3,132.

# SHARE LIST OF ELECTRICAL COMPANIES.

## TELEGRAPH AND TELEPHONE COMPANIES.

| Present issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1891. | 1892. | 1893. | Closing Quotation, November 7th. | Closing Quotation November 14th. | Business done during week ended November 14th, 1894. Highest. | Lowest. |
|---|---|---|---|---|---|---|---|---|---|
| 173,400/ | African Direct Teleg., Ltd., 4 % Deb. ... ... ... | 100 | ... | ... | ... | 102 —105 | 102 —105 | ... | ... |
| 1,012,880/ | Anglo-American Teleg., Ltd. ... ... ... ... ... | Stock | £2 12s. | £2 15s. | £2 11s. | 36 — 38 | 35 — 37 | 38½ | 36¼ |
| 2,993,560/ | Do. do. 6 % Pref. ... ... ... ... ... | Stock | £5 5s. | £5 10s. | £5 2s. | 71½— 72½ | 70 — 71 | 71¾ | 70⅛ |
| 2,993,560/ | Do. do. Defd. ... ... ... ... ... ... | Stock | ... | ... | ... | 6¼ — 6⅜ | 6¼ — 6⅜ | 6⅜ | ... |
| 130,000 | Brazilian Submarine Teleg., Ltd. ... ... ... | 10 | 8 % § | 6¼% § | 6½% § | 12½— 13 | 11½— 11⅝ | 13 | 11⅝ |
| 75,000/ | Do. do. 5 %, repayable June 1906 ... ... | 100 | ... | ... | ... | 110 —114 | 110 —114 | ... | ... |
| 44,000 | Chili Telep., Ltd., Nos. 1 to 40,000 ... ... ... ... | 5 | ... § | 10%‖ § | ... § | 2 — 3 | 2 — 3 | 2⅛ | ... |
| 10,000,000$ | Commercial Cable Co. ... ... ... ... ... ... | $100 | 7 % | 7 % | 7 % | 135 —145 | 135 —145 | ... | ... |
| 224,850 | Consolidated Telep. Const. and Main., Ltd. ... ... | 10/- | 3½% § | 2 % § | 2 % § | ¼ — ¼ | 1/16— 3/16 | ... | ... |
| 16,000 | Cuba Teleg., Ltd. ... ... ... ... ... ... | 10 | 8 % | 8 % | 8 % | 12½— 13½ | 12½— 13¼ | 12⅝ | ... |
| 6,000 | Do. 10 % Pref. ... ... ... ... ... | 10 | 10 % | 10 % | 10 % | 19 — 20 | 19 — 20 | ... | ... |
| 12,931 | Direct Spanish Teleg., Ltd., £4 paid ... ... ... | 5 | 4½% | 4 % | 4 % | 4¼— 4⅜ | 4¼— 4⅜ | ... | ... |
| 6,000 | Do. do. 10 % Pref. ... ... ... ... | 5 | 10 % | 10 % | 10 % | 9¼— 9½ | 9¼— 9⅜ | ... | ... |
| 30,000/ | Do. do. 4½ % Debs of £50, Nos. 1 to 1,600 | ... | ... | ... | ... | 105 —108% | 105 —108% | ... | ... |
| 60,710 | Direct United States Cable, Ltd., 1877 ... ... ... | 20 | 3½% § | 3½% § | 2⅝% § | 8 — 8½ | 8 — 8½ | 8 7/16 | 8½ |
| 400,000 | Eastern Teleg., Ltd., Nos. 1 to 400,000 ... ... ... | 10 | 6½% § | 6½% § | 6½% § | 15⅝— 15⅞ | 15⅝— 15⅞ | 16 | 15⅝ |
| 70,000 | Do. 6 % Pref. ... ... ... ... ... | 10 | 6 % § | 6 % § | 6 % § | 16¼— 17 | 16¼— 17 | 16⅞ | 16 7/16 |
| 102,100/ | Do. 5 % Debs., repay. August, 1899 ... ... | 100 | ... | ... | ... | 106 —110 | 106 —110 | ... | ... |
| 1,297,837/ | Do. 4 % Mort. Deb. ... ... ... ... ... | Stock | ... | ... | ... | 119 —122 | 117 —120 xd | 121½ | 118 |
| 250,000 | Eastern Extension, Australasia and China Teleg., Ltd. ... | 10 | 7 % | 7 % | 7 % | 15⅜— 16 | 15⅞— 16⅛ | 16 1/16 | 15⅞ |
| 54,100/ | Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326 | 100 | ... | ... | ... | 103 —106 | 103 —106 | 105½ | 104 |
| 194,300/ | Do. do. Bearer, 1,050—3,975 and 4,327—6,400 | 100 | ... | ... | ... | 103 —106 | 103 —106 | ... | ... |
| 320,000/ | Do. 4 % Deb. Stock ... ... ... ... ... | Stock | ... | ... | ... | 116 —120 | 116 —120 | ... | ... |
| 95,100/ | Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343 | 100 | ... | ... | ... | 103 —106 | 103 —106 | ... | ... |
| 129,100/ | Do. do. do. to bearer, 2,344 to 5,500 | ... | ... | ... | ... | 103 —106 | 103 —106 | 104 | ... |
| 300,000/ | Do. 4 % Mort. Debs. Nos. 1 to 2,016, red. 1909 | 100 | ... | ... | ... | 104 —107 | 104 —107 | ... | ... |
| 200,000/ | Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000 | 25 | ... | ... | ... | 107—110% xd | 107 —110% | 109⅜ | 108 |
| 180,227 | Globe Telegraph and Trust, Ltd. ... ... ... ... | 10 | 5¼% § | 4⅞% § | 4⅝% § | 8⅝— 8⅞ | 8⅝— 8⅞ | 8⅞ | 8 11/16 |
| 180,042 | Do. do. 6 % Pref. ... ... ... | 10 | 6 % § | 6 % § | 6 % § | 15¼— 16 | 15¼— 16 | 16 | 15⅞ |
| 150,000 | Great Northern Teleg. Company of Copenhagen ... ... | 10 | 8⅜% § | 8⅜% § | 8⅜% | 20½— 21½ | 20½— 21½ | 21 | 20 13/16 |
| 190,000/ | Do. do. do. 5 % Debs. | 100 | ... | ... | ... | 105 —108 | 105 —108 | ... | ... |
| 17,000 | Indo-European Teleg., Ltd. ... ... ... ... ... | 25 | 10 % | 10 % | 10 % | 46 — 48 xd | 46 — 48 | ... | ... |
| 37,548 | London Platino-Brazilian Teleg., Ltd. ... ... ... | 10 | ... | ... | ... | 5 — 7 | 5 — 7 | ... | ... |
| 100,000/ | Do. do. 6 % Debs. ... ... | 100 | ... | ... | ... | 107 —110 | 104 —107 | 108½ | ... |
| 15,000 | Monte Video Teleph. Co., Ord., 1 to 15,000 ... ... | 5 | ... | ... | ... | ¼— ¾ | ¼— ⅜ | ... | ... |
| 28,000 | Do. do. 6 % Pref., 1 to 28,000 ... ... | 5 | ... | ... | ... | 1 — 2 | 1 — 2 xd | ... | ... |
| 484,597 | National Teleph., Ltd., 1 to 438,984 ... ... ... ... | 5 | 6 % § | 5 % § | 5 % § | 4⅞— 5⅛ | 4⅞— 5⅛ | 5 1/16 | 4 15/16 |
| 15,000 | Do. 6 % Cum. 1st Pref. ... ... ... | 10 | ... | ... | ... | 15 — 16 | 15 — 16 | ... | ... |
| 15,000 | Do. 6 % Cum. 2nd Pref. ... ... | 10 | ... | ... | ... | 14½— 15½ | 14½— 15½ | 15½ | ... |
| 119,234 | Do. 5 % Non-cum. 3rd Pref., 1 to 90,950 | 5 | ... | ... | ... | 5⅛— 5⅜ | 5⅛— 5⅜ | 5⅜ | 5 11/16 |
| 1,000,000/ | Do. 4½ % Deb. Stock Prov. Certs. ... | ... | ... | ... | ... | 110 —113 | 110 —113 | 111¼ | 110 |
| 48,800 | New Teleph., Ltd., 25,901 to 74,700; £4 paid ... ... | 10 | ... | ... | ... | ... — ... | ... — ... | ... | ... |
| 171,504 | Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid | 1 | ... | ... | ... | 1/16— 1/16 | 1/16— 1/16 | ... | ... |
| 100,000/ | Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000 | 100 | ... | ... | ... | 104 —107 | 104 —107 | ... | ... |
| 11,839 | Reuter's Ltd. ... ... ... ... ... ... ... | 8 | 5 % | 5 % | 0 % | 3 — 5 | 3 — 5 | ... | ... |
| 3,381 | Submarine Cables Trust ... ... ... ... ... | Cert. | ... | ... | ... | 103 —108 | 103 —108 | 106 | 103⅜ |
| 58,000 | United River Plate Teleph., Ltd. ... ... ... ... | 5 | ... | ... | ... | 2 — 3 | 2 — 3 | ... | ... |
| 146,733/ | Do. do. 5 % Debs. ... ... ... | Stock | ... | ... | ... | 88 — 94 | 88 — 94 | ... | ... |
| 15,609 | West African Teleg., Ltd., 7,501 to 23,109 ... ... ... | 10 | 4 % | .. | 0 % | 3 — 5 | 3 — 5 | ... | ... |
| 249,900/ | Do. do. do. 5 % Debs. ... ... ... | 100 | ... | ... | ... | 100 —103 | 100 —103 | ... | ... |
| 30,000 | West Coast of America Teleg., Ltd. ... ... ... ... | 10 | ... | ... | ... | 1½— 2½ | 1½— 2½ | ... | ... |
| 150,000/ | Do. do. do. 8 % Debs., repay. 1902 | 100 | ... | ... | ... | 101 —106 | 101 —106 | 102 | 101 |
| 64,242 | Western and Brazilian Teleg., Ltd. ... ... ... ... | 15 | 4 % | 2½% | 2½% | 9¼— 9⅜ | 10 — 10½ | 11 | 9½ |
| 33,129 | Do. do. do. 5 % Cum. Pref. ... | 7½ | ... | ... | ... | 6½— 7 | 6¼— 6⅞ | 7 | 6½ |
| 33,129 | Do. do. do. 5 % Def. ... ... | 7½ | 3 % | ... | ... | 3¼— 3⅜ | 4¼— 4⅜ | 5⅛ | 3⅜ |
| 171,900/ | Do. do. do. 6 % Debs. "A," 1910 ... | 100 | ... | ... | ... | 107 —110 | 103 —106 | ... | ... |
| 214,800/ | Do. 6 % Mort. Debs., series "B," red. Feb. 1910 | 100 | ... | ... | ... | 107 —110 | 103 —106 | ... | ... |
| 88,321 | West India and Panama Teleg., Ltd. ... ... ... | 10 | ¼% | ¼% | 8⅜% | 1⅛— 1⅜ | 1 — 1¼ | ... | ... |
| 34,563 | Do. do. do. 6 % 1st Pref. ... | 10 | ... | ... | ... | 11 — 11½ | 11 — 11½ | 11 1/16 | 11 1/16 |
| 4,669 | Do. do. do. 6 % 2nd Pref. ... | 10 | ... | ... | .. | 9 — 10 | 9 — 10 | ... | ... |
| 80,000/ | Do. do. 5 % Debs. (1917) No. 1 to 1,000 | 100 | ... | ... | ... | 108 —111 | 108 —111 | ... | ... |
| $1,211,000 | Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ... | $1000 | ... | ... | ... | 112 —118 xd | 112 —118 | 116⅜ | ... |
| 166,900/ | Do. do. 6 % Ster. Bonds. ... ... | 100 | ... | ... | ... | 102 —104 | 102 —104 | ... | ... |

## ELECTRICITY SUPPLY COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 30,000 | Charing Cross and Strand Electy. Supply, 1 to 6, 215 to 718, and 10,001 to 30,000 | 5 | ... | 5 % | 4½% | 4½— 5½ | 4½— 5½ | ... | ... |
| 40,000 | City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000 | 10 | ... | ... | ... | 12½— 13½ | 12 — 13 | 13 | ... |
| 40,000 | Do. do. 6 % Cum. Pref., 1 to 40,000 | 10 | ... | 6 % | 6 % | 14¾— 15¼ | 14¾— 15¼ | 15¼ | 14⅞ |
| 100,000 | Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid | ... | ... | ... | ... | 131 —133 | 131 —133 | ... | ... |
| 50,000 | †Liverpool Electric Supply, all paid ... ... ... ... | 5 | 4½% | 5 % | 5 % | 6 2/16— 6 1/16 | 6⅜— 6⅜ | 6⅜ | ... |
| 49,900 | *Metropolitan Electric Supply, Ltd., 6,101 to 50,000 ... | 10 | 1 % | 2 % | 2½% | 9¼— 9⅜ | 9¼— 9⅜ | 9 1/16 | 9⅜ |
| 100,000/ | Do. 5% Deb., 1 to 10,000 in bonds of £10, £20, £40 | ... | ... | ... | ... | ... — ... | ... — ... | ... | ... |
| 6,452 | Notting Hill Electric Lightg. Co., Ltd. ... ... ... | 10 | ... | ... | ... | 6 — 7 | 6¼— 7⅛ | 7⅛ | 6 11/16 |
| 19,980 | St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-18,780 | 5 | 8¼% | 7¼% | 4½% | 7⅜— 8¼ | 7⅜— 8 | 7⅞ | 7⅜ |
| 20,000 | Do. do. 7 % Pref., 20,081 to 40,080 | 5 | 7 % | 7 % | 7 % | 8⅜— 9¼ | 8⅜— 9¼ | 9 1/16 | ... |
| 59,900 | *Westminster Electric Supply Corp., Ord., 101 to 60,000 ... | 5 | ... | 3½% | 4 % | 7 — 7⅛ | 7 — 7⅛ | 7⅜ | 7⅛ |

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

## SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

### ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1891. | 1892. | 1893. | Closing Quotation, Nov. 7th. | Closing Quotation, Nov. 14th. | Business done during week ended Nov. 14th, 1894. Highest. | Lowest |
|---|---|---|---|---|---|---|---|---|---|
| 90,000 | Brush Elecl. Enging. Co., Ord., 1 to 90,000 ... ... ... | 3 | ... | 6 % § | 6 % § | 2⅜ — 2⅝ | 2⅛ — 2⅜ | 2 9/16 | 2 3/16 |
| 90,000 | Do. do. Non-cum. 6 % Pref., 1 to 90,000 | 2 | ... | 6 % § | 6 % § | 2⅜ — 2⅝ | 2⅛ — 2¼ | 2⅛ | 2 5/16 |
| 125,000/ | Do. do. 4½ % Deb. ... ... ... | Stock | ... | ... | ... | 111 —114 | 110 —113 | 111¼ | 110 |
| 630,000/ | City and South London Railway ... ... ... ... | Stock | ... | ⅝% | ⅝% | 37 — 39 | 37 — 39 | 36¾ | ... |
| 28,180 | Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180 | 5 | 7 % § | 7 % § | 7 % § | 2¼ — 2⅜ | 2½ — 3 | ... | ... |
| 50,000/ | Do. do. 5 % 1st Mort. Debs., 1—400 of £100, and "A" 1—200 of £50 each | ... | ... | ... | ... | 95 —100 | 95 —100 | ... | ... |
| 120,000 | Electric Construction, Ltd., 1 to 120,000 ... ... ... | 2 | ... | ... | ... | ⅜ — ⅝ | ⅜ — ⅝ | ... | ... |
| 12,845 | Do. do. 7 % Cum. Pref., 1 to 12,845 ... | 2 | ... | ... | ... | 1½ — 2 | 1½ — 2 | 1 9/16 | ... |
| 100,000 | Elmore's French Patent Cop. Deposg., Ltd., 1 to 66,750 ... | 2 | *nil* | *nil* | *nil* | ¼ — ½ | ¼ — ½ | ... | ... |
| 91,195 | Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000 ... ... | 2 | *nil* ¶ | *nil* | *nil* | 1⅜ — 1 25/32 | 1⅜ — 1 25/32 | 1⅜ | ... |
| 67,385 | Elmore's Wire Mfg., Ltd., 1 to 67,385, issued at 1 pm. ... | 2 | *nil* | *nil* | *nil* | 1¼ — 1 29/32 | 1¼ — 1 29/32 | ... | ... |
| 20,000 | Fowler-Waring Cables, Nos. 301 to 20,300 ... ... ... | 5 | *nil* § | *nil* § | *nil* § | ½ — 1½ | ½ — 1½ | ... | ... |
| 9,600/ | Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ... | 10 | 7 % | ... | ... | 6½ — 7½ | 6½ — 7½ | ... | ... |
| 6,837 | Henley's (W. T.) Telegraph Works, Ltd., Ord. ... ... | 10 | 5 % | 5 % | 5 % | 8 — 9 | 8 — 9 | ... | ... |
| 50,000 | India-Rubber, Gutta Percha and Teleg. Works, Ltd. ... | 10 | 12½% | 12½% | 12½% | 25 — 26 | 25 — 26 | 25⅞ | 25⅝ |
| 200,000 | Do. do. do. 4½ % Deb., 1896 | 100 | ... | ... | ... | 102 —104 | 102 —104 | ... | ... |
| 37,500 | †Liverpool Overhead Railway, Ord. ... ... ... ... | 10 | ... | ... | 1 % | 8 — 8⅛ | 7 15/16 — 8 1/16 | 8⅛ | ... |
| 6,295 | † Do. do. Pref., £8 paid ... ... | 10 | ... | ... | ... | 13 — 13¼ | 13 — 13¼ | ... | ... |
| | Swan United Electric Light, Ltd. ... ... ... ... | ... | 11 % § | 10 % § | 7½% § | ... — ... | ... — ... | ... | ... |
| 37,350 | Telegraph Constn. and Maintce., Ltd. ... ... ... | 12 | 20 % | 15 % | 20 % | 41 — 43 | 41 — 43 | 42¾ | 41⅞ |
| 150,000/ | Do. do. do. 5 % Bonds, red. 1894 | 100 | ... | ... | ... | 106 —109 | 106 —109 | ... | ... |
| 54,000 | Waterloo and City Railway, Nos. 1 to 54,000, £2 paid ... | 10 | ... | ... | ... | 2⅛ — 2⅜ | 2⅛ — 2⅜ | 2⅜ | 2¼ |

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0% §; 1891—7% §; 1890—8% §.

### LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5⅜—6.
Electric Construction Corporation, 6 % Debentures, 87—92.
Electric and General Investment, shares of £5 (£1 paid), 1⅜—2¼.
House-to-House Company (£5 paid), 2⅛—2¼.
Do. do. 7 % Preference, of £5, 6⅛—6⅜.
Do. do. 6 % Debentures of £100, 101—103.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 4¾—5¼; 1st Preference Cumulative 6 %, £5 (fully paid), 6¼—6¾.
Liverpool Electric Supply, £5 (fully paid), 6⅜—6½.
London Electric Supply Corporation, £5 Ordinary, ⅞—1⅛.
Queen Anne's Mansions Lighting and Heating Company, 6 % £100 Debentures, 101—103.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares (£4 10s. paid), 4¼—4¾.

Bank rate of discount, 2 per cent. (February 22nd, 1894).

## PROCEEDINGS OF SOCIETIES.

### Institution of Electrical Engineers.

Notes on Electric Tramways in the United States and Canada. (Supplementary Paper.)* By H. D. Wilkinson. Read Thursday, November 8th, 1894.

While the single trolley system is almost entirely universal, I took pains to find out such details of the double trolley system in Cincinnati, and the underground conduit in Chicago and Washington, as I judged would interest the members of this Institution, not only on account of their using an insulated return, but also on account of possible practical utility in their mode of working.

For the details of these systems I must refer you to the original paper; but, in order that the points put forward on the various systems may be made clear, I have had some diagrams prepared which show the general scheme of each.

Considering, first, the predominating single trolley overhead system—the mileage of which to-day in the United States and Canada exceeds that of all the steam, cable, and horse traction systems put together by 50 per cent., and to which, owing to its exceedingly adaptable and flexible character, the enormous development of electric traction in those countries has been due—we have the current supplied to the cars through the medium of a bare copper wire stretched centrally over the rails of the track at a height of about 19 feet from the ground. The current is collected from this wire by means of a thin steel tube and trolley wheel mounted on the roof of the car, the wheel running on the under side of the wire, and being kept up to the same by springs on the tube. The current is conveyed by an insulated wire to the controlling and reversing switches and fuse to the motors, a lightning arrester also being in circuit.

The overhead trolley wire is divided into sections of one-quarter or half a mile in length, insulated from each other, and supplied with current from the power station by separate insulated feeders.

As each section is independently supplied, it follows that the size of the trolley wire does not depend on the length of line, but simply on the length and average load per section, and is therefore uniform in size throughout, and generally about ⅓-inch in diameter.

On this system the current passes from the electric motors to the iron frame of the car, and thence by the wheels to the rails and earth. As the earth presents an almost infinite mass compared with the rails, it was assumed in the first instance that a return of least resistance would be secured by well earthing the negative poles of the dynamos. The coal bill, however, stimulated enquiry into the losses in transmission of electric energy.

On many lines of five to 10 miles the voltage at the most distant section between trolley wire and rails was only 50 per cent. of that generated at the station.

Some improvement was made by sinking deeper earths into moist soil and connecting the same to more points on the rails. But at the best this was unreliable and variable, and it was noticed that improvement was more marked when attention was turned to the rails themselves as the best return conductor.

High resistance fish plate joints were bridged over by iron and then by copper wires, and the rails at their nearest point of approach to the power station were connected by overhead return cables to the dynamos, thus affording a reliable metallic return, while at the same time the earth formed part of the circuit.

In Stage 2, we have the rails connected at intervals to water and gas pipes; this step creating, from the traction companies' point of view, a most satisfactory rise of potential on the line, and improvement in speed of cars at the distant points on their system, but also raising the potential of the pipes above that of the earth, and bringing into existence electrolytic pitting and corrosion, followed by leakage and danger, and producing, as the secretary of the gas company in Washington described to me, a feeling akin to sitting on the top of a volcano. The electrolytic consequences ensuing on this method of "helping out" the return circuit led to a reconsideration of the matter.

It was found impracticable to root out all such connections, or to provide such inspection as should prevent its recurrence; but the action was mitigated by clamping copper bands round the pipes at affected points, the same being connected to cables leading directly to the negative collecting bars in the power station.

All this pointed to the advantage of a metallic return, and led to the use of the supplementary wire shown in Stage 3. This consisted of a bare copper rod, wire, or cable, laid on the sleepers between the rails throughout their entire length, connected by twisted and soldered wires to the rails on each side of the fish-plates, and cross-connected to a similar wire in the adjoining track every 30 yards. But on all lines which I have seen being laid in this manner the wires have been uniform in section throughout (about ⅜-inch diameter for the central wire, with smaller wires to bridge the rail joints), instead of increasing in section as they approach the power station in proportion to the increased volume of current. Unless proportioned to admit of constant density of current, I fail to see that this attains the desired end.

Through all the stages thus far, the idea has been retained that the negative poles of the dynamos must be connected directly to earth at the power station. Doubtless, if there are no return feeders and poor rail-bonds, or if the return feeders are of insufficient section to carry the current ousted from rails so bonded, a portion of the current will take to the earth and metallic bodies within it on its way

* Abstract.

back to the generators; but, although it will cost a little more, I think we can afford to dispense entirely with the alternative earth path, and should do without it. The safety of buried pipes and cables would thus be assured, and the efficiency of transmission increased.

It may be urged that the rails are perforce in contact with earth, and therefore the alternative earth path is always present. The answer to that is, Let the negative poles of the dynamos be connected to the rails direct by insulated cables, but not to earth at the station, and the current will then be kept within the rails and return feeders. The only chance for current to pass to earth would be as a shunt round bond joints of high resistance or insufficient conductivity; and should this occur, it will only cause electrolytic corrosion at such joints, and not on underground pipes and cables.

Having arrived at this point, I now divide the exclusively metallic return so obtained under two heads, viz., feeders and rails. If we put return feeders to every half-mile of rails, as we put them to every half-mile section of trolley wire, the bonds become of lesser importance; that is, firstly, they need only be of section sufficient to take the maximum current *per section*; and secondly, they will be of uniform sectional area throughout. All the return current is then collected by the feeders, and returned to the generators direct. Each feeder collects or drains off the return current for a certain distance on each side of its point of attachment to the rails; and when current is collected in this manner at several centres along the route, it cannot all rush to one spot, near the power station, where the density is not only seriously increased, but voltage and power are wasted.

But if we do without return feeders altogether, then the current is returned entirely by the rails, and the bonds are of great importance.

Since the original paper was commuicated, rail bonding has been much improved, and I believe we can thoroughly rely upon these joints as permanent connections. Adequate area of contact with the rail, and that of a permanent character, are the main points.

I have taken exception to the supplementary wire; but if increased in section, say every quarter of a mile, as it approaches the power station, it would do nearly as well as insulated feeders, provided the connections from the rails to the generators were made at the nearest point to the power station by insulated cables. On lines where the route rounded curves or loops, it would not do as well, because the current might find a short cut across corners if the earth favoured. By this method, also, current would be "bunched" at one point, instead of being collected and returned at intervals by feeders.

I now come to the double trolley overhead system.

In the original paper I have given an account of my visit to Cincinnati, Ohio, where this system is in operation. I went there to look into the system with an open mind and ascertain whether there were any adequate advantages to be gained for the use on one track of two overhead wires and two trolleys instead of one.

The idea and the principle were, of course, complete insulation from earth.

I need not repeat here what I have already reported as having seen in Cincinnati, but I may summarise by saying that I found one of the trolley wires in connection with earth, although not in direct connection. I could light the lamps in a single trolley car by changing the trolley wheel on to one of the double trolley wires which ran over the same track. However, no direct path for the return current through the earth would be offered by one wire being earthed, because there was (as there must be with this system) a complete return circuit of insulated feeders from the sections of negative trolley wire to the generators, in a similar manner to that on the positive side.

In other words, the return circuit was a complete duplication of the outgoing circuit, and the dynamos delivered their current outwards by insulated feeders, and received it back by insulated feeders of equal capacity.

Any connection of either trolley wire to earth, therefore, could not cause a flow of current directly from the rails to the generators, since the latter were not in connection with earth *at the power station*.

That this fact was an advantage, in view of electrolytic troubles resulting from return currents through earth, I could not doubt; but, notwithstanding the mechanical and commercial success of the double trolley in this city, I could not but reflect that, if we are to have overhead wires at all, *one* is better than *two*, and there might be other ways of effecting the same object.

This led me to look at the single trolley system again, and to ask myself the question, "Would not the same immunity from return earth currents be secured if, instead of earthing the generators and favouring an earth path, the return current should be collected direct from the rails by insulated feeders in communication with the negative side of the generators?" I am convinced that it would, and that the gaining of such immunity by insulated return feeders, connected at half-mile intervals to the rails on a single trolley system, quite compensates for the extra cost.

This conclusion strengthens the position of the single trolley, while, so far as any superior advantage is to be gained, it disposes of the double trolley.

At the same time, I am bound to admit that, notwithstanding the increased amount of overhead work, and the extra insulation required at points and crossings, no serious mechanical difficulty presents itself in the double trolley; and the Board of Affairs of that city have acknowledged its practicability and success in authorising considerable extensions.

In the three-wire system, of which I have prepared a diagram of the outside circuit, two 500-volt generators are connected in series, the middle wire being to earth, and the free positive and negative terminals connected to the feeders radiating from the station. The single overhead trolley wire is used, divided as usual into sections insulated from one another, so that the outside line work is precisely the same as in the two-wire system. Instead, however, of these sections being all of positive potential, they are connected alternately to the positive and negative feeders. Thus only a small part of the total current used in propelling the cars returns by the rails or earth to the station, and that only when the load is not balanced on the different sections of opposite potential. For this reason, I heard that the system was to be tried in districts affected by pipe corrosion on some of the great lines in Massachusetts, but with what result I have not heard.

I was very pleased to see Messrs. Siemens's defence of the Buda-Pesth conduit line, which is both exhaustive and timely. Somehow or other, an impression has prevailed that a 1½-inch slot is inseparable from an electric system; whereas the case at Buda-Pesth was that advantage was taken of the wheel flange slot already existing, and this was necessarily somewhat wide. There is no difficulty in making the slot ⅝ inch, and bedding the insulated wires of the collector in a ½-inch steel carrier.

The conduit and slot in the centre of the track, however, is the most satisfactory, as it is not subjected to any continuous wear from the travel of the cars.

Of the two systems of electric street tramways, the single trolley is most suitable for outlying districts, and the conduit for towns.

Although necessarily moving slower in town streets on account of the traffic, and therefore not showing all their good points, it must not be overlooked that electric cars have tractive power to tackle ascents of 1 in 10; and the running expenses per car mile are cheaper than by horses.

The use of storage batteries I have not touched upon. There have been trials in America, but less experience gained than in England and the Continent. If the cost of depreciation and renewal, which is out of all proportion to that of the transmission systems, could be materially reduced, the self-contained battery system would claim attention for town and city traffic. Data on recently worked lines on this system would be welcomed from members who have had experience of such lines.

There is a limit to the amount of power it is economical to supply from one point only. The cost of insulated feeders comes in as a considerable item in first cost on lengths above five miles, and the loss of voltage and energy in transmission of the current is a continuous one. I think it worth while to consider high tension transmission by underground feeders and the use of motor transformers, or the direct use on ordinary lines of what the Americans call "boosters," or motor generators; or, again, the three-wire system, or the establishment of power stations situated, not as they are now, namely, in the centre, from which lines radiate outwards, but at the most distant points, and feeding towards a centre.

While it is evident that the combination of fortuitous conditions in the Canadian Falls line is very exceptional, yet I am of opinion that, by keeping these and other favourable conditions in view, there are many districts in our own country where electric tram lines could be put down at once with advantage.

I have drawn attention in my paper to some points in power station plant, more particularly with reference to fly-wheel strains under the exceptionally sudden changes of load in street tramway work, which are sometimes the cause of serious mishaps. The ordinary fluctuations in load are caused by the starting or stopping by chance of a number of cars at the same instant, the variations being at times from over full load to quarter load; and the more excessive fluctuations are due to short circuits, or the sudden release of load by automatic circuit breakers. In one large station of 4,000 H.P. I was informed that the average was 20 short circuits per day. Most of these were temporary, and caused either by high winds shifting some of the overhead gear, or falling telegraph or telephone wires, but in exceptional cases caused by the trolley wire itself breaking and falling on to the rails or ground. An overload or short circuit, when driving by belt, puts a sudden brake on the periphery of the fly-wheel and a shearing strain on the spokes.

The belt, of course, slips, but at times it parts or is thrown off, and in the course of its career sometimes damages the governor and leaves the engine uncontrolled, under which circumstances it is rare if there is time to shut down before something goes; and, as they tersely put it on the other side, it is best to get behind a pillar and await developments. The bending strains set up in the rim by centrifugal force in a racing engine appear to have been the cause of more fractures of the wheel than the shearing strains.

The reason for wheels with one to two thousand foot-tons of stored energy is, presumably, to secure regulation of speed in engines having a small number of steam admissions per unit of time; but I think it will be admitted that the governor has more chance of producing an immediate effect upon the speed when there are a large number of admissions per unit of time, and there is the additional advantage in the use of much smaller and solid fly-wheels of approximately one-tenth the stored energy, and therefore well able to "stand the racket" with safety.

Regarding the use of belts, I think engineers in the States are coming to see that it is worth while to put a little more material in the generators and do without these weak links in the chain of transmission. At any rate, I noticed many of the newer plants were direct-driven, with marine-type engines.

I admit that there is something very stately and imposing in a long row of trip-gear engines with large fly-wheels and belts. I enter very keenly into the enjoyment of such a sight, and am also much impressed by the number of yards super. in stone and brick outside the building, and feet super. of floor inside; but when we have to consider capital cost of works, and adaptability of plant to get down in good shape to its work under trying conditions with safety, we may wisely let such considerations take a secondary place.

In conclusion, I may be permitted to say that, while judging such information as I could bring to bear upon the question as it affects us in this country to be of interest to our engineers, as it certainly has

been given me with infinite open-handedness and cordiality by my American friends, I do not cease to recognise the great labours and genius of our great engineers and electricians who have frequently addressed you in this room, and from the Presidential chair in both this Institution and the Institution of Civil Engineers, and whose indomitable perseverance and energy have led the van in laying the earliest electric rails in the United Kingdom.

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Electric Traction, with Special Reference to the Installation of Elevated Conductors.* By Robert W. Blackwell, Foreign Member, and Philip Dawson, Associate. Read Thursday, November 8th, 1894.

Probably no practical point in electric traction was less understood a few years ago than "rail-bonding," and a few words may be added to what has been said on that subject. Its importance has but recently been appreciated, and it is of *first* importance. It may be taken that the bonds connecting rails should be, as nearly as possible, of the same current capacity as the metals themselves. If a 70-lb. rail be used, the sectional area of copper bonds should be as nearly as possible ¾ths of a square inch, the ordinary steel rail having approximately ⅛th as much conductivity as commercially pure copper. This would exceed nine No. 0 copper wires.

When electric roads were first constructed, a No. 4 galvanised iron wire was considered sufficient!

Prof. Jackson, of the University of Wisconsin, has found by experiment that the chemical composition of the soil has a great influence on corrosion. The most favourable to it, and having the smallest resistance, is that in which there is the greatest proportion of chlorides. Nitrates come next, and sulphates last.

As has been before said, the contact between rail and bond should be as near as possible seven times the sectional area of a bond wire sufficient to carry the given current. The sections shown exhibit the construction very fully. While the solid copper bond possesses all the flexibility found to be necessary, it is made, when desired, with flexible stranded copper cable between the terminals.

Whether electric welding will eventually take the place of all bonding is still an undecided question. It has not yet stood the test of practical use on a large scale for a sufficiently long period to pronounce an opinion.

When first introduced in Boston it was not successful, many rails breaking near the joint after some months' use. The process has since been improved, and a trial section of line was in course of being welded when the "West End" Street Railway was visited last June. Seven miles of welded track have given satisfaction for some months in St. Louis. Over 100 miles are now being welded in Brooklyn, and the result of this trial will demonstrate, after a year or two, the value of welding. At present it takes from 10 to 15 minutes to make a welded joint, and, on an average, a current of about 250 ampères at 550 volts is necessary, which is transformed into an alternating current at 2 to 3 volts pressure. Approximately, each joint costs 12s. to 15s.

It is worth mentioning that modern American practice is to butt the rails, allowing nothing for expansion, wherever the streets are paved. The result is a nearly perfect joint.

With heavy cars, having at least 4 or 5 tons load on each axle, this is of the highest importance.

Mr. Wilkinson refers to the possible adoption of the three-wire system for electric tramways. That system has been in satisfactory use in Portland, Oregon, for the past four years. Compound-wound generators, working at 500 volts without load, and 550 volts with full load, are used. The success of this system depends upon the load of the various sections being nearly balanced. At Milwaukee, where local conditions did not allow of proper balancing, the system was tried, and given up as a failure. The three-wire system was introduced at Portland because the generating station was three miles away from the nearest point of the line, and the cost of feeders would have been necessarily heavy. By the three-wire system 1,100 volts could be used, — 550 and + 550, between each two sections of trolley wire. The rails were connected to the neutral terminal at the switchboard. The average load on this station is 1,500 H.P. It is located near a huge lumber mill, and the fuel is carried by automatic conveyers directly from the waste lumber yard into the furnace. Several tramways derive their power from this station, at a cost of about 25s. per H.P.-month, 18 hours' daily work. Thomson watt-meters register the current used. The station pays about 40s. a day for its supply of fuel.

The enormous carrying power of an electric tramway, at a pinch, is an interesting feature. The following figures, given by Mr. Bowen, of the Chicago City Street Railway Company, show the work done by his electric line on "Chicago Day" at the World's Fair:—

Fifty-one double motor cars, 10 single motor cars, and 73 trail cars were in operation over 26 miles of track. During the day 208,575 passengers were carried, and 11,271 car miles run. The maximum output at the power house was 17,000 ampères, and the average for 20 hours about 1,050. The minimum current registered was 750 ampères, and the average station pressure 540 volts. The ratio of expenses to receipts on this line is 40 per cent.

A word may be said in support of what Mr. Wilkinson has said as regards the appearance of overhead conductors. Undoubtedly some aerial lines have been put up with an utter disregard of appearances, and inexperienced or careless constructors have erected webs of trolley strain and feeder wires which were most obnoxious. This is especially true of many hastily built American lines, pushed through at high pressure, and at the smallest possible expenditure. Now that the first rush is over, and the tramway operator, the manufacturer, and the contractor have had time to take breath, the weight of public and press criticism has had its effect, and no pains is spared to perfect the entire plant and apparatus.

A carefully designed and erected line, with sub-surface feeders, handsome poles, &c., has but few objectionable features; and in the great majority of cases public convenience is so greatly enhanced by the overwhelming advantages that closely follow upon the introduction of improved and more rapid transit facilities, that opposition to the extension of a trolley line is almost unknown.

The Siemens line at Guernsey, the line that crosses the great piazza on which Milan Cathedral stands, the Brussels, Hamburg, Bremen, and a dozen other Continental installations, are European examples of line construction to which no reasonable objection can be urged. The electric tramway has a future as great in Great Britain as elsewhere, and in no other country in the world has it failed to already secure universal acceptance.

The English tramway operators, and the able executive officers of the Tramways Institute of Great Britain and Ireland, are keenly alive to the possibilities that lie in electric traction, and, under most adverse conditions, are doing their best to smooth the path of progress. It remains with you, gentlemen, to supplement their endeavours, and to do your best to stimulate and encourage the growth of public opinion in its favour.

* *Abstract.*

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## The Northern Society of Electrical Engineers.

Lighting Installations. By H. A. Henderson. Read November 12th, 1894.

For the purpose of this paper, installations may be divided into two classes, good and bad; but I shall divide the latter into two subclasses, namely (*a*), installations, which, although they may not be of the best, are still good enough to pass the usual examination and test of the supply company's inspector, and (*b*) those which do not fulfil this condition. I have not much to say about Class I., except that this quality of installation depends upon three essentials, namely, good supervision, good labour, and good material.

To my mind the most interesting objects for discussion are included in Class II., so I will at once pass on to these. As we saw that good installations depend upon three essentials, so we may say that any one of these being absent produces a result contained in either subclass *a* or *b*. First, then, let us briefly touch upon supervision. This is a point upon which I cannot lay too much stress, and I fear it is only too often neglected by just the very class of contractors amongst whom one would expect to find it. The reason of this is not difficult to surmise. It is that the busy contractor cannot spare the time to devote to it that he ought, as he has many enquiries, and special technical work to attend to, which he is unable to trust to his juniors. The immediate effect is that the work being left perhaps under the control of incompetent men, and most of us know what the average wireman does under these circumstances, the installation falls into Class II., and this, notwithstanding the fact that the best material may have been supplied. It is perhaps unnecessary for me to mention that, under these conditions, the weak point is, as a rule, bad joints.

Bad joints in an installation are perhaps the most difficult faults to find out, as one cannot possibly, in the course of an inspection, pretend to critically examine every one. Generally the outside appearance is good, and unless the joint be absolutely cut open, its weak points are not discovered. There is an example before you of a joint which, upon a superficial examination, is very good, but it is in reality about as dangerous a combination of unskilful workmanship as one would wish to meet with.

First we find only one point of contact between the conductors, and this probably rendered bad by the presence of rubber, thus we should be certain to get a heating effect owing to the high resistance. Then instead of stripping the braiding or outer covering of the wire back, and leaving the vulcanised rubber to form an insulator, the braiding is carefully bound in *on to* the conductor, and in case of general dampness, would make a fairly easy path for the passage of the current to earth. I may mention that the examples of joints on the table are reproductions of actual ones that I have myself taken out of installations. I am bound, however, to state that these sort of specimens are not often met with now. Out of over 500 installations which I have inspected and tested within the last 18 months, only a small percentage were absolutely bad. I have found that the two most dangerous types of contractor to deal with are the plumbing-electric bell fitter and the "freshman" at the technical school. Two instances of installations carried out respectively by a plumber and a student will suffice to show what I mean. In the first one of some 18 or 20 lights a superficial examination seemed satisfactory. That is, the *mains* and all easily accessible wires were apparently of good quality. The insulation resistance, however, was below 10 ohms, and a further investigation revealed the fact that ordinary bell-wire of a quality similar to the sample on the table had been used and bedded in new plaster without any casing, tubes, or protection whatever. It was necessary for me to actually dig out the wires before I could discover this. Needless to say, being a very low tender, the contractor lost his money and the confidence of his client.

The second example was a case where the best material had been used and everything done upon the most approved scientific lines, but upon turning on the current the lamps only came up dull red. The reason of this was that the number of lamps being even, and on two-light electroliers, they were wired in pairs of two in series, "because," as the contractor informed me, "he could not get four wires down the tube of the fitting!"

Such cases as these are, however, I am happy to state, growing fewer day by day. Before I dismiss this portion of my subject I must just add a word or two upon the various systems of wiring premises. In Manchester we are, perhaps, more favourably situated than in any other town in England, as we have the alternative of wiring either on the three or five-wire systems. The latter plan has been adopted with

great success in several installations here, notably, the Town Hall, Royal Exchange, Free Trade Hall and Reference Library, and the advantage both to the contractor and the consumer is considerable. In the case of the contractor it saves labour, and in the case of the consumer current. There are also many installations wired either on the wire system or on a modification of it, which are very satisfactory, and show a considerable saving in copper. I am inclined to think, however, that in the majority of provincial towns the most improved system of wiring is not recognised. As an instance I may state from statistics that over 50 per cent. of the installations in Manchester are wired upon the now almost obsolete "Tree system." That is, a pair of mains are run throughout the building, and lights tapped on indiscriminately as they are required without regard either to the carrying capacity of the leads, or the proper protection of the branches by cut-outs. I have come across cases, for instance, where a branch of 18-gauge wire to carry three lights was tapped directly on to a pair of 20's. No doubt the second wireman who was instructed to put on the extra lights was conscientious to a certain extent, but not sufficiently so to pull out the existing tapping and run his 18's direct to the main.

Such proceedings as this do not conduce to the satisfactory adoption of the electric light by the general public, who—and this is a fact we should never lose sight of—are to a great extent ignorant of technical details, and are in the majority of cases entirely in the hands of their contractors.

In my opinion, the most satisfactory way of wiring is that which now commonly obtains in London, and has also been adopted by a few provincial contractors, namely, the distribution system, confining oneself, as far as possible, to 5 ampère sub-circuits, each controlled by a double pole fuse. The advantage of this to the consumer is considerable, as it allows extra lights to be attached without much extra cost, providing, of course, that the contractor has allowed for this in his mains. Unfortunately, however, it is hard to explain to the prospective consumer that the small additional cost at the outset will probably be of advantage to him later; for a large proportion of the British public are inclined to accept the lowest tender, their object being to put in the light for the present without regard to the future. As to prices at which work is obtained, it would of course be invidious on my part to mention any figures, but when one sees, as I have done, variations of as much as 300 per cent. in tenders to specification, one cannot help feeling that there is something wrong somewhere.

Of course it may be argued that certain contractors can buy material in a cheaper market than others, but I fear that this is not altogether a satisfactory explanation. One is rather led to the opinion that perhaps low quotations are a bait to catch work by contractors who are not already sufficiently established. There is at present going on in our papers a discussion as to whether certain manufacturers should be contractors. I think with regard to cable manufacturers, that perhaps it is somewhat unfair for them to compete with their clients, as friction is sure to be caused by such a proceeding. The manufacturers of fittings, perhaps, come under a different aspect, as a contractor is frequently asked for a special design or form of fitting, which, if he is himself a manufacturer, he can supply at short notice and comparatively moderate cost, whereas if he has to go to an outside firm, unless he is in a position to order a quantity, such firm will naturally charge him a high price, and the delay in delivery may be considerable.

As far as regards cables and wires the quality is fixed, and one is obliged to employ the particular form and size which is required.

The employment of efficient labour is of very great importance, and this brings me to the second essential. I may say that I have had a large and varied experience of the so-called wireman, and a very interesting and curious study I have found him. I suppose there are black sheep in every fold, but I am sure that the wireman's fold is particularly well supplied with the article. One finds among them individuals who seem to be given up to almost every form of vice from which they should be free. It is evident that the employment of these specimens of humanity is sure to result in trouble; yet sometimes the unfortunate contractor has no alternative. In the busy season one is often only too glad to get hold of a man who knows the difference between a double pole cut-out, and a main switch, and your average wireman lets you know that he recognises this by demanding high wages or assuming an independent attitude. Perhaps I may be pardoned for suggesting that a paper on the subject of improving the condition of the electrical labour market would be of great interest, at any rate to a majority of our members.

I will now pass on to the third essential, the use of good material, and I fear that in these days of cheap Continental rubbish, this important point is often neglected. There are at the present time Continental firms who may be said to run English contractors, that is to say, they get hold of a contractor who is short of capital, and finance him by supplying him with inferior material, mainly fittings, at a low price. It is a matter for regret that such practices obtain, but I suppose they cannot be improved except by strict supervision on the part of the supply companies' installation inspector, and even then only to a limited extent, as there are loop holes in clients who instal their own plant, and who are thus independent of this source of criticism. Fittings are a very important factor in keeping up the quality of an installation, and one which I fear many supply inspectors neglect. Often the inspector places too much confidence in his insulation test, or in the quality of the insulating material of wires and cables, without stopping to see if lamp-holders or switches are defective, or proper cut-outs put in where they should be. Either of these points, if neglected, is a source of great annoyance, or may be danger, to the consumer, and allow inferior contractors to obtain jobs at low prices.

Then again, as I have before mentioned, prospective consumers often make a great mistake in accepting a very low tender, on the supposition that it is economical to save a few pounds at first. The remedy for this lies in the employment of a consulting engineer. But I fear that even consulting engineers are not altogether free from partiality. When one sees in a specification, for instance, a certain make of switch mentioned, one cannot get away from the feeling that perhaps there is more in it than the mere fact that the particular make of switch is efficient. However, consulting engineers have a great power in controlling the abuses of the trade, and one which I am sure we should all be glad to see more universally used. I fear that perhaps I have dwelt at too great length on some points which may seem trivial, while only briefly touching upon others which have an important significance; but if it should be thought that any portion of my paper is worthy of discussion, I feel sure that many of our members would take a lively interest in it, and probably do more justice to this very interesting subject than I have done.

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## The Société Internationale des Electriciens.

Meeting of November 7th, 1894.

At this inaugural meeting. two interesting papers were read. The first was by M. G. Pellissier, who furnished some very interesting facts relating to the electrical transmission of the time in America, where this application of electricity has entered the domain of industry.

The United States is, for this purpose, divided into four horary sectors or districts, the extent of each being about 15°, *i.e.*, the time in each sector differs by 60 minutes from that of the adjoining one. The correct time is transmitted every day at the same time by means of very simple methods from the New York central offices (Eastern sector) to all the towns, railways, post offices, &c., in America.

The original idea of dividing the globe theoretically into 24 horary sectors is certainly worthy of attention, for its general application would be attended by fewer drawbacks than are met with in the States and countries in which the system actually works, and would enable the same minute to be indicated by all the standard clocks of the whole world, the hour only differing according to the geographical position of the sector considered.

In the second paper, M. Ch. Maréchal showed experimentally, by means of an electro-chemical actinometer, that luminous energy is transformed into electrical energy mechanically—available even at long distances—not through the calorific or chemical power of the light, but by virtue of a third force, which the writer calls actinic force.

This transformation is effected in all the divisions of the spectrum, but depends on the colouring matter employed for sensitising the plates of the actinometer, the sensitiveness of which is so great that the light of a candle at a distance of some metres produces effects that are as clear as they are instantaneous.

After discussing certain applications to telegraphy and photography, M. Maréchal in an hypothesis which, though bold, is based on facts ascertained by observation and experiment, shows once more the close connection between electrical and luminous phenomena; then he showed the intimate relations existing between solar light and the great natural phenomena, such as terrestrial magnetism, the different variations of the magnetic needle, the aurora borealis, earth currents, &c.

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## NEW PATENTS—1894.

20,693. "An improved acoustic device for telephones." A. Maseland. Dated October 29th.

20,703. "Improved telephone switch and indicator." G. L. Anders. Dated October 29th.

20,716. "Improvements in and connected with portable electric-lighting circuits and illuminating devices." P. T. Letchford. Dated October 29th.

20,735. "A new or improved process for manufacturing bodies which are to be raised to incandescence." O. Tiegs. Dated October 30th. (*Complete.*)

20,746. "An electrical prepayment gas meter." F. Villiers-Stead. Dated October 30th.

20,783. "An improved telephone transformer." J. W. Ray. Dated October 30th.

20,784. "Improvements in electric incandescent or arc lamps." H. J. B. Thiroux. Dated October 30th.

20,807. "Improvements in telegraph transmitters." H. A. Taylor. Dated October 30th.

20,827. "An improved telephone switchboard jack." J. Taylor. Dated October 31st.

20,842. "Improvements in propelling road and railway vehicles by electricity." T. Machin. Dated October 31st.

20,843. "Improvements relating to road or railway vehicles propelled by electricity." T. Machin. Dated October 31st.

20,853. "Improvements in advertising and electrical station and stopping-place indicators for vehicles." F. Villiers-Stead. Dated October 31st.

20,886. "Improvements in and relating to telegraphic relays." A. D. MacDonald. Dated October 31st. (*Complete.*)

20,917. "Improvements in or connected with incandescent electric lamps." H. H. Hall. Dated November 1st.

20,944. "Improved telephonic switch for inter-communication." G. L. Anders. Dated November 1st.

20,959. "New or improved regulating switch for electric lamps and other electric apparatus." A. E. Williamson, E. L. Joseph, and The Electric Light Regulating Syndicate, Limited. Dated November 1st.

21,043. "Improvements in the method of damping marine and other mirror galvanometers making them absolutely dead beat." T. Clark and T. E. Weatherall. Dated November 2nd.

21,045. "Improvements in alternate current dynamo-electric machines." M. Hutin and M. Leblanc. Dated November 2nd.

21,080. "Improvements in secondary batteries." C. Laugier. Dated November 2nd.

21,098. "A novel or improved process and means for obtaining electrical energy from fuel gases." W. Borchers. Dated November 3rd. (*Complete.*)

21,104. "Improvements in grooved mouldings or casements for the concealment of electric wires and the like, in combination with picture rail and such like mouldings." G. Grant. Dated November 3rd.

21,140. "Apparatus for controlling electrical illumination." Siemens Bros. & Co., Limited. (Communicated by Messrs. Siemens and Halske, Germany.) Dated November 3rd.

21,141. "Improved means for controlling the induced currents in short-circuited windings of the armatures of electromotors worked with rotary phase alternating currents." Siemens Bros. & Co., Limited. (Communicated by Messrs. Siemens & Halske, Germany.) Dated November 3rd.

21,142. "Improvements in apparatus for starting and reversing the motion of electromotors." Siemens Bros. & Co., Limited. (Communicated by Messrs. Siemens & Halske, Germany.) Dated November 3rd.

## ABSTRACTS
## OF PUBLISHED SPECIFICATIONS, 1893.

22,186. "Improvements in lock and block electric apparatus for railways." E. Tyer. Dated November 20th. Relates to the apparatus described on page 580.

23,337. "Improvements in electric meters." H. C. L. Holden. Dated December 5th. Relates to instruments which depend for their principle of working on the extension or increase of length which takes place in a wire or wires through which an electric current is passing, whereby they are heated. 1 claim.

23,385. "Improvements in galvanometers." E. W. Jewell and W. Zimmerman. Dated December 5th. Two similar bell magnets are placed with like poles facing on the same axial line having between them a ring armature leaving a small space between the magnets and armature. Diametrically opposed on said ring are two coils formed of a single piece of insulated wire of which the central part connects said coils, which are free to move on said armature. Said coils are carried on arms of a metal shaft having its axis coincident with that of the magnets. The ends of said shaft turn in insulated jewelled bearings. Said insulations each also hold an arm whereof the end thereof holds the end of a coiled spring of which the opposite or inner end is held on an insulated sleeve on said shaft. Said spring turns said coils and holds them to one end of the magnetic field. The outer ends of said coils are carried inward on the arms of said shaft, one going to the upper and the other to the lower hub of said spring to which they are fastened. The arms of said springs are connected with binding posts, through which the outer connection is made. 15 claims.

24,243. "An improvement in electrical arc lamps." W. H. Lauder. Dated December 16th. Consists of a cut-out in the shunt circuit which may take the form of a brass lever pivoted in the centre with an adjustable weight running along one limb holding the limb down and making contact through shunt circuit. The other limb is in such a position as to be rested on by the tripper which descends and undoes brake or clutch allowing the carbon rod to feed forward or downward. 3 claims.

### 1894.

1,473. "Improvements in dynamo-electric machines." H. H. Lake. (Communicated from abroad by G. F. Dieckmann, of Chicago.) Dated January 23rd. Designs to utilise the electric impulses developed through magnetic induction at the internal circuit in the armature coil of the familiar dynamo machine for the production there in a suitable secondary coil of an extra or additional electric current which can be thence distributed for external use. 6 claims.

2,007. "An electric switch." The Edison and Swan United Electric Light Company, Ltd., and C. F. Proctor. Dated January 30th. Relates to an electric switch provided with a spring so arranged that, when the handle is pulled over, contact is rapidly broken. 1 claim.

2,203. "An improvement in electric candle lamps." G. Durlacher, A. Lacoste, and W. Lowry. Dated February 1st. Consists of an electrical glow lamp mounted on a white or coloured tube representing a candle. 1 claim.

2,514. "Improvements in or relating to electric bells." J. H. West. Dated February 5th. Claims:—1. Alternately closing and breaking the circuit by means of a pendulous clapper free to move in one direction but restrained in the other direction by a contact moving with the armature of the electro-magnet, substantially as described. 2. Apparatus substantially as described and shown in the drawing.

2,562. "Improvements in electrical tramways and railways." F. M. Ashley. Dated February 6th. One of the features of the invention is an insulating joint for the rails upon which the vehicle travels. Another feature of the invention is the use of an entirely closed conduit located in the roadbed and an apparatus for maintaining a pressure of circulation of heated air in the conduit for the purpose of keeping it dry. 13 claims.

2,593. "Improvements in gas engines." H. H. Lake. (Communicated from abroad by W. W. Grant, of New York.) Dated February 6th. Relates to a type of explosive gas engine which, although operative with an admixture of fixed gases, is more particularly designed with reference to the employment of a liquid hydro-carbon, as gasolene, and the admixture, vaporisation, and explosion thereof, with atmospheric air. 21 claims.

2,812. "Improvements in methods of and apparatus for the generation of electric currents of defined period." Nikola Tesla. Dated (under international convention), August 19th, 1893. Consists in producing electric currents of constant period by means of an engine and an electrical generator which are so constructed and related that (*a*), the engine of itself is capable of imparting to the moving element of the generator an oscillation of constant period, or (*b*) the period of reciprocation of the engine and the natural rate of vibration of the electric system will so nearly approximate as to act in resonance, or (*c*), the engine, while fully capable of maintaining a vibration once started has not the power to change its rate, so that the electric system will entirely control its period. 6 claims.

2,900. "Improvements relating to the electro-deposition of metals." J. Rudholzner. Dated February 9th. The inventor arranges in the electrolytic bath between the article and the anode freely suspended plates consisting of insulating material, such as glass, ebonite, or the like, and provided with larger or smaller apertures. By this means the parts of the article which are directly opposite the apertures receive a thicker coating of metal than those parts which are protected more or less from the direct action of the current by the plates suspended in front. 4 claims.

3,020. "Improvements in induction electrical machines." F. Tudsbury. Dated February 12th. Claims:—1. In an induction electrical machine covering, embedding, or enclosing the metallic inductors or carriers in or between the material of which the cylinders or discs are constructed, and providing them with studs or connecting pieces to pierce the outer or friction surface of the said cylinders or discs in the manner and for the purposes substantially as described and illustrated. 2. In an induction electrical machine placing and arranging the metallic inductors or carriers covered, embedded or enclosed as described in Claim 1, in such a manner that the studs or connecting pieces may be brought in line of contact with one wide or with two, three, or more narrow neutralising brushes in the manner and for the purposes substantially as described and illustrated.

3,045. "An improved electric insulating compound." L. Baarnhielm, and A. Jernander. Dated February 12th. Claim:—An insulating compound consisting chiefly of vulcanised stearin pitch.

3,223. "Improvements in the heating of gases by electricity." W. Donaldson. Dated February 14th. The inventor passes the gases to be heated through a tube or elongated chamber, within which he arranges a wire, or partial conductor of an electrical current, insulated from the said tube or chamber, but in naked contact with the gases to be heated. 3 claims.

3,273. "Improvements connected with arc lamps." A. Chester and J. J. Rathbone. Dated February 15th. The inventors arrange a low resistance coil in parallel with the main circuit but operative by its magnetic force upon the same armature as is controlled by the high resistance coil or electro-magnet, the said low resistance coil being put into circuit when the arc resistance increases beyond the normal. 2 claims.

3,384. "Improvements in incandescent electric lamps." J. W. Turnbull. Dated February 16th. The object of the invention is to produce an improved incandescent electric lamp in which a central tube or enclosed passage is employed as a means of ventilation for keeping the lamp cool, and as a reflector introduced within the filaments, and in which the central tube is made a separable part to provide for the renewal, and at a comparatively small cost, of the filaments when they shall have burned out. 16 claims.

3,730. "Improvements in electric arc lamps." E. A. Claremont. Dated February 21st. Claims:—1. In an electric arc lamp, the use of a metallic disc or base in combination with a recess in which is fitted a toothed wheel on a spindle supported in bearings passing through the sides of said recess and attached to the case of the lamp, in the manner and for the purpose substantially as hereinbefore described. 2. In an electric arc lamp the use of an insulated metallic disc or base for supporting the mechanism of lamp, in the manner and for the purpose substantially as described.

4,909. "Improvements in or relating to combined targets and electrical indicating apparatus." G. H. Collins and C. S. Jones. Dated March 8th. Has reference to improvements in or relating to combined sectional targets and electrical apparatus for automatically indicating at the firing station the value obtained for each shot fired, and also the approximate position of the portion of the target struck. 6 claims.

5,276. "Improvements in electric railways." J. F. Cummings and E. M. Engelman. Dated March 13th. Consists in an improved construction of conduit, travelling contacts, conductors, and means for testing them. 2 claims.